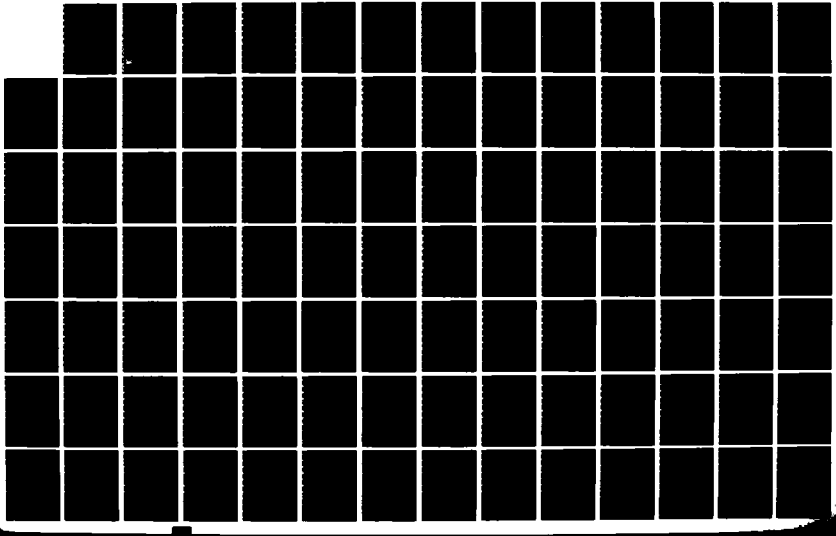
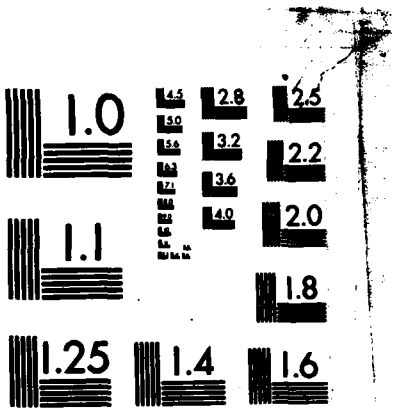
AD-A140 789 RED RIVER OF THE NORTH RECONNAISSANCE REPORT: PARK RIVER SUBBASIN(U) GULF SOUTH RESEARCH INST BATON ROUGE LA DEC 80 DACW37-80-C-0017 1/2

UNCLASSIFIED F/G 8/8 NL

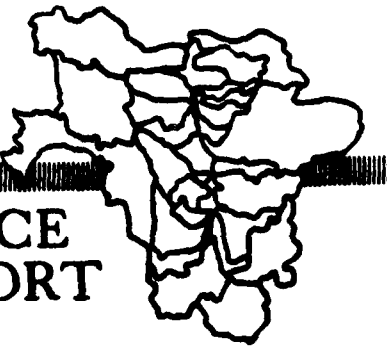




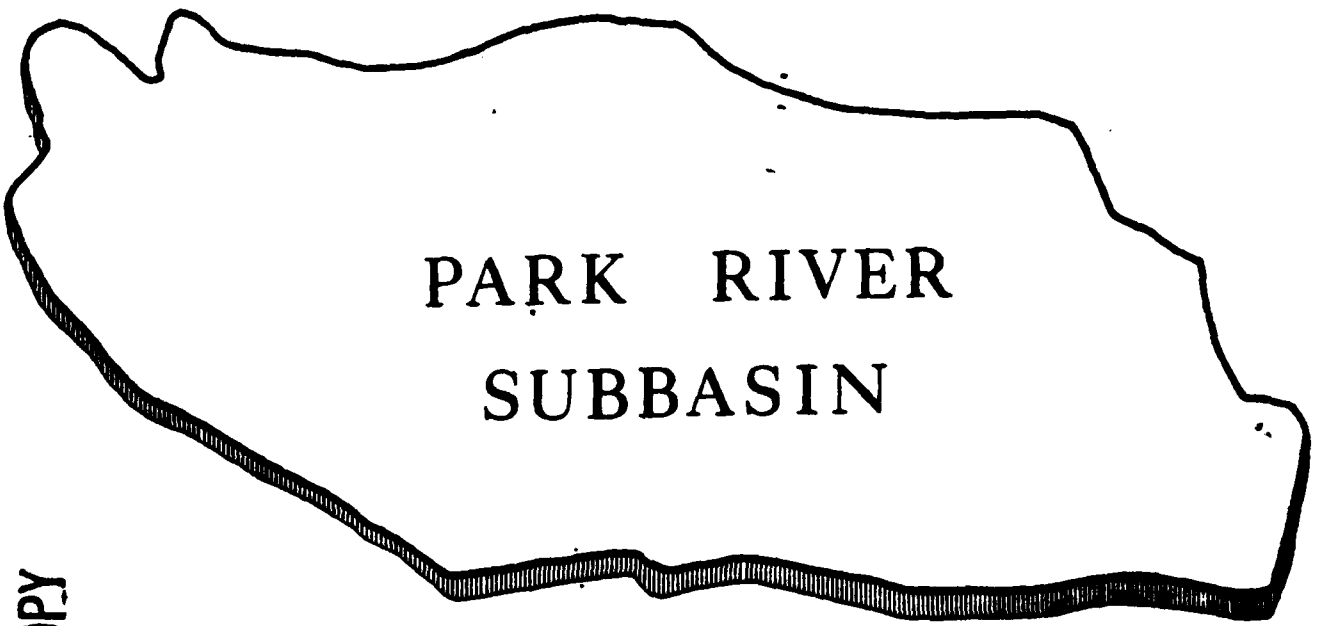
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

(2)

RED RIVER OF THE NORTH



RECONNAISSANCE REPORT



PARK RIVER SUBBASIN

FINAL REPORT
December 198

ST. PAUL DISTRICT: U.S. ARMY CORPS OF ENGINEERS

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A140 789	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) RED RIVER OF THE NORTH, RECONNAISSANCE REPORT: PARK RIVER SUBBASIN		5. TYPE OF REPORT & PERIOD COVERED Final Report
		6. PERFORMING ORG. REPORT NUMBER GSRI Project No. 955
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s) DACW37-80-C-0017
9. PERFORMING ORGANIZATION NAME AND ADDRESS GSRI/Gulf South Research Institute P.O. Box 14787, Baton Rouge, LA 70898		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Paul 1135 USPO & Custom House St. Paul, MN 55101		12. REPORT DATE 1980
		13. NUMBER OF PAGES 111 pages
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES Bois de Sious-Mustinka Rivers; Buffalo River; Devils Lake; Elm River; Forest River; Goose River; Maple River; Middle River; Main Stem; Ottertail River; Park River; Pembina River; Red Lake; Roseau River; Sand Hill River; Sheyenne River; Rush River; Snake River; Tamarac River; Two Rivers; Turtle River; Wild Rice-Marsh Rivers, Wild Rice River (N.D.) & Summary Report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

FLOOD CONTROL
FLOODING
WATER RESOURCES
RED RIVER BASIN

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report is one of 23 subbasin reports produced by the St. Paul District Corps of Engineers in connection with a reconnaissance report for the whole of the Red River Basin. The reconnaissance report is itself part of the overall Red River of the North study, which was initiated by Congress in 1957 in order to develop solutions for flooding problems within the basin.

The purpose of a reconnaissance study is to provide an overview of the water and related land resource problems and needs within a particular geographic area, to identify planning objectives, to assess potential solutions and

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

problems, to determine priorities for immediate and longrange action, and to identify the capabilities of various governmental units for implementing the actions.

The information developed in this report has been combined with information developed in the other subbasin reports to produce a main report covering the basin as a whole. The various flood control measures discussed in this and in other subbasin reports are combined in the main report to develop the outline of an integrated flood control plan for the basin within the context of a comprehensive plan.

The Park River Subbasin occupies 1,010 square miles of the northern North Dakota portion of the Red River Basin and includes portions of Walsh, Pembina, and Cavalier counties. It is bordered on the north by the Pembina River Subbasin, on the south by the Forest River Subbasin, on the east by the Main Stem Subbasin, and on the west by the Devils Lake Subbasin.

gsri GULF SOUTH RESEARCH INSTITUTE
P.O. Box 14787 Telephone Area Code 504 766-3300 Baton Rouge, Louisiana 70893

December 1980

Final Report

Contract No. DACW37-80-C-0017
GSRI Project No. 955

Accession For	
NTIS GRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

RECONNAISSANCE REPORT: RED RIVER OF THE NORTH BASIN, PARK RIVER SUBBASIN

Prepared for:

U.S. Army Corps of Engineers
St. Paul District
St. Paul, Minnesota

TABLE OF CONTENTS

Section		Page
I	THE STUDY AND REPORT.	1
II	DESCRIPTION OF STUDY AREA	3
III	PROBLEMS, NEEDS, AND DESIRES.	6
	Flooding Problems.	6
	Nature of the Problems.	6
	Location and Extent	8
	Flood Damages	9
	Environmental Concerns	11
	Recreational Problems.	12
	Water Quality Problems	13
	Water Supply Problems.	14
	Erosion Problems	14
	Irrigation	14
	Wastewater Management Problems	15
	Hydropower	15
	Public Perception of Problems and Solutions.	15
IV	DESCRIPTION OF SUBBASIN RESOURCES	19
	Social Characteristics	19
	Economic Characteristics	20
	Employment.	20
	Income.	20
	Business and Industrial Activity.	21
	Environmental Characteristics.	24
	Climate	24
	Geology	24
	Biology	24
	Water Supply.	31
	Water Quality	31
	Aesthetics.	34
	Cultural Elements	34
	Recreational Resources	35
	Significant Environmental Elements	36
	Social.	36
	Cultural.	36
	Soils	38

TABLE OF CONTENTS (Cont'd)

Section		Page
	Water	38
	Woodlands	38
	Wetlands	39
	Grasslands	40
	Waterfowl Production Areas	42
	Wildlife Management Areas	44
	Threatened or Endangered Species	44
	Other Important Species	44
	Rare and Unique Plants	44
	Natural Areas	45
V	FUTURE CONDITIONS	46
	Most Probable Economic Conditions	46
	Most Probable Agricultural Conditions	47
	Evaluation of Flood Damages--Future Conditions	48
	Most Probable Environmental Conditions	50
	Without Project Conditions	50
VI	EXISTING FLOODPLAIN MANAGEMENT PROGRAMS	51
	Institutions	51
	Structural Measures	52
	Nonstructural Measures	54
	Adequacy of Existing Measures	55
VII	CRITERIA AND PLANNING OBJECTIVES	56
	Floodplain Management Criteria	56
	Planning Objectives	56
VIII	FORMULATION OF ALTERNATIVE MEASURES	58
	Engineering Methodology	60
	Nonstructural Measures	60
IX	ASSESSMENT OF ALTERNATIVES	63
	Economic Assessment	63
	Impact assessment	65
	Farmstead Levees	66
	Land Treatment and Structural Measures, North Branch Park River	67
X	EVALUATION	68
XI	ADDITIONAL STUDY NEEDS	69

TABLE OF CONTENTS (Cont'd)

Section		Page
	BIBLIOGRAPHY	72
	Appendix A: FLOODPLAIN DELINEATION.	A-1
	Appendix B: INVENTORY OF OUTDOOR RECREATIONAL FACILITIES, Park River Subbasin	B-1
	Appendix C: COMMENTS.	C-1

LIST OF TABLES

Table Number		Page
1	Park River Subbasin, Estimated 1979 and Average Annual Urban Flood Damages	10
2	Park River Subbasin, Estimated 1975, 1979 and Average Annual Rural Flood Damages	11
3	Wastewater Treatment and Needs of Ten Communities within the Park River Subbasin	16
4	1978 Crop Statistics, Park River Subbasin	22
5	Manufacturing Establishments, Park River Subbasin	23
6	Harvest Data for Game and Furbearing Animals in Pembina and Walsh Counties, Park River Subbasin	29
7	Water Quality Data from Two Major Tributaries within the Park River Subbasin	32
8	Water Quality Data for Three Wells near Homme Reservoir, Park River Subbasin	33
9	1964 Wetland Inventory Data for the Three Counties Included by the Park River Subbasin	41
10	Waterfowl Production Areas (WPAs) and Wetland Easement Areas of the Counties Included in the Park River Subbasin	42
11	Park River Subbasin, Population, Employment, and Per Capita Income Projections, 1970-2030	46
12	Park River Subbasin, Principal Crops and Projected Production 1980-2030	47
13	Park River Subbasin, Summary of Present and Future Average Annual Damages Urban, Agricultural, and Transportation	49
14	Economic Evaluation of Alternatives	64
15	Assessment of Measures, by Resource Element, Park River Subbasin	65

LIST OF ILLUSTRATIONS

Figure Number		Page
I	Park River Subbasin.	4
II	100-Year Floodplain.	7
III	Recreational Resources	37
IV	Waterfowl Production Areas	43
V	Existing Flood Control Measures.	
VI	Alternative Flood Control Measures	

I. THE STUDY AND REPORT

I. THE STUDY AND REPORT

This report is one of 23 subbasin reports produced by the St. Paul District Corps of Engineers in connection with a reconnaissance report for the whole of the Red River Basin. The reconnaissance report is itself part of the overall Red River of the North Study, which was initiated by Congress in 1957 in order to develop solutions for flooding problems within the basin.

The purpose of a reconnaissance study is to provide an overview of the water and related land resource problems and needs within a particular geographic area, to identify planning objectives, to assess potential solutions and problems, to determine priorities for immediate and long-range action, and to identify the capabilities of various governmental units for implementing the actions.

The Park River Subbasin is a water resource planning unit located in the northern North Dakota portion of the Red River Basin. This report describes the social, economic, and environmental resources of the subbasin, identifies the water-related problems, needs, and desires, and suggests measures for meeting the needs, particularly in the area of flood control.

The report was prepared almost entirely on the basis of secondary information. However, some telephone contacts were made to verify information and to acquire a more complete picture of local conditions. The comprehensive reports available on the subbasin include the following: (1) Park River Subbasin, North Dakota, a communication from the Assistant Secretary of the Army (Civil Works), which was published in 1976 and contains correspondence in answer to two house resolutions on Park River Subbasin flood control measures and states the advisability of adopting the proposed project; (2) Water Resources Fact Sheet on Water Management Alternatives for Park River Subbasin, various dates, which was published by the St. Paul District Corps of Engineers; (3) Social and Economic Considerations for Water Resources Planning in the Park River Subbasin, North Dakota, which was published by the University of North Dakota in 1971; and (4) Interim Survey Report for Flood Control and Related Purposes, Park River Subbasin, North Dakota, which was published in 1973 by the St. Paul District Corps of Engineers. Other published sources on the subbasin include:

1. Watershed Work Plan for Watershed Protection and Flood Prevention, Willow Creek-Park River Watershed, which was published in 1964 by the U.S. Soil Conservation Service and described the proposed flood protection plans for the watershed.

2. Work Plan for Watershed Protection and Flood Prevention, Middle Branch Park River Watershed, which was published in 1972 by the U.S. Soil Conservation Service and described the proposed flood protection plans for the watershed.

3. Environmental Impact Assessment of the Homme Dam and Reservoir, North Dakota, which was published by the Institute for Ecological Studies, University of North Dakota, in 1974 and describes the impacts which have resulted from the construction of the dam and reservoir.

4. Interim Survey for flood Control and Related Purposes, Park River Subbasin, meeting with State Water Commission and Grafton Regarding Local Support for Project, which was published in 1974 by the St. Paul District of Corps of Engineers and is a summary of a meeting with the North Dakota State Water Commission.

5. Final Environmental Impact Statement, Flood Control at Grafton, North Dakota, Park River, which was published by the St. Paul District Corps of Engineers in 1975 and describes proposed flood control measures at Grafton.

6. Environmental Aspects of Two Water Management Alternatives in the Park River Subbasin, North Dakota, which was published by Paul W. Kannowski as Research Report No.1, University of North Dakota, Grand Forks, in 1971 and describes two methods of flood control for the South Branch and Main Stem of the Park River.

In addition, the subbasin received partial coverage in the Souris-Red-Rainy River Basins Comprehensive Study, which was published by the Souris-Red-Rainy River Basins Commission in 1972, and in the Red River of the North Basin Plan of Study, which was published by the St. Paul District Corps of Engineers in 1977.

The information developed in this report has been combined with information developed in the other subbasin reports to produce a main report covering the basin as a whole. The various flood control measures discussed in this and in other subbasin reports are combined in the main report to develop the outline of an integrated flood control plan for the basin within the context of a comprehensive plan.

II. DESCRIPTION OF STUDY AREA

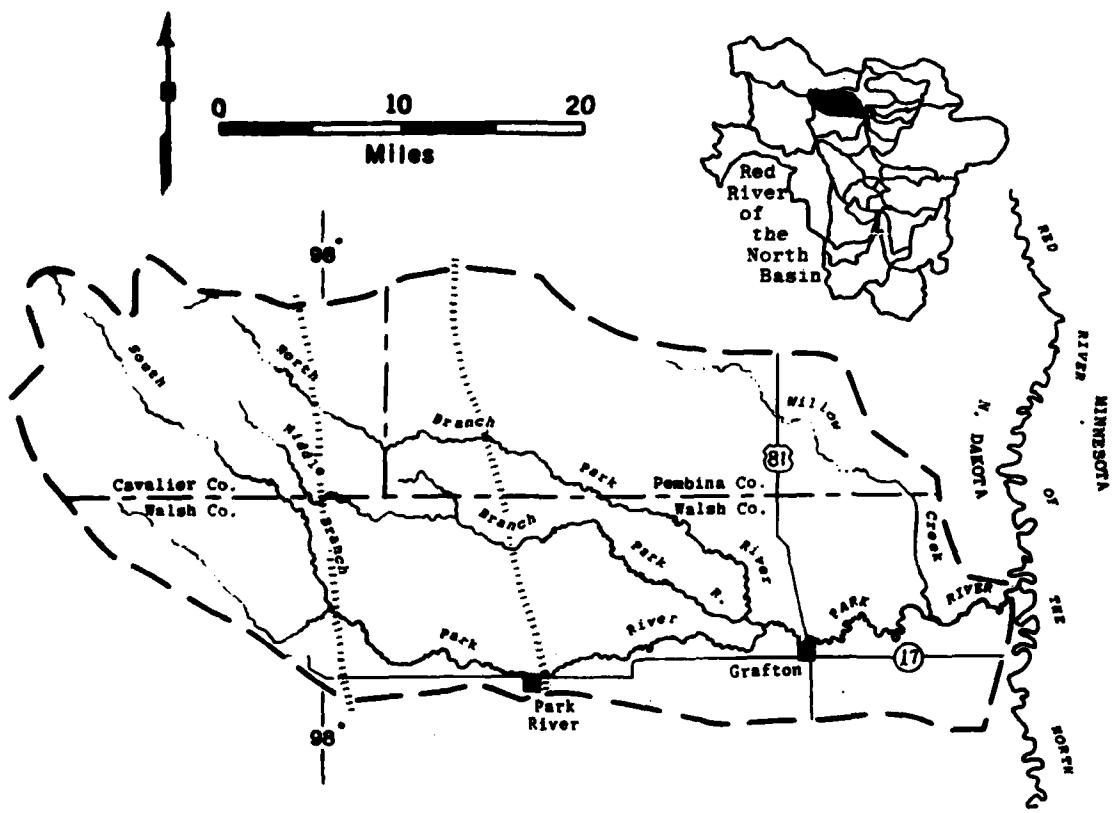
II. DESCRIPTION OF STUDY AREA

The Park River Subbasin (Figure I) occupies 1,010 square miles of the northern North Dakota portion of the Red River Basin and includes portions of Walsh, Pembina, and Cavalier counties. It is bordered on the north by the Pembina River Subbasin, on the south by the Forest River Subbasin, on the east by the Main Stem Subbasin, and on the west by the Devils Lake Subbasin.

The subbasin includes two well-defined topographic subdivisions of the great Interior Plains region of North America: the Drift Prairie Plateau in the west; and the Red River Valley in the east. The transition from the moderately rolling ground moraine of the Drift Prairie Plateau to the flat bed of glacial Lake Agassiz, which comprises the Red River Valley, occurs in two stages. The most significant transition is through the Pembina Escarpment northeast of Adams, North Dakota. After the escarpment, the Park River passes through a moderately dissected outwash plain before reaching the beach ridges of glacial Lake Agassiz near Park River. The terrain slopes about 30, 20, 5, and 3 feet per mile in the escarpment, the outwash plain, and the glacial lake bed, respectively, with very little defined terrain slope in the Drift Prairie region.

The headwaters of the various streams in the subbasin rise in the Drift Prairie of southeastern Cavalier County at an approximate elevation of 1,600 feet above mean sea level. The three principal headwater streams--the South, Middle, and North Branches of the Park River--emerge from the Drift Prairie escarpment about 13 miles west of Grafton and flow in a southeast and easterly direction to an almost common confluence 2 or 3 miles west of Grafton. From this point the Park River main stem meanders eastward across the flat Red River Valley plain and joins the Red River of the North 36 miles south of the international boundary at about elevation 760. The drainage area above Grafton is 695 square miles, with the South, Middle, and North Branches containing 297 square miles (43 percent), 165 square miles (24 percent), and 233 square miles (33 percent), respectively.

The stream characteristics of the South Branch Park River are quite varied, ranging from a broad shallow valley in the Drift Prairie area



Source: Gulf South Research Institute.

Figure I. PARK RIVER SUBBASIN

to a wide, deeply entrenched valley in the escarpment and outwash plain area. In the glacial lake bed area, the river becomes a gently meandering stream with a shallow bed and streambanks at or slightly above the elevation of the adjacent plain. The main stem Park River has characteristics similar to the lowest reach of the South Branch, although the width of the stream is greater. The Middle and North Branches also have characteristics similar to the South Branch in the respective reaches.

The valley widths and depths, respectively, are about one-fourth mile and 30 feet in the Drift Prairie area, one-half mile and 130 feet in the escarpment, one-half mile and 80 feet in the outwash plain, and 2.5 miles and 20 feet in the glacial lake bed area. The stream slopes are about 3 feet, 30 feet, 20 feet, 5 feet, and 1 foot per mile in the Drift Prairie, escarpment, outwash plain, and upper and lower glacial lake bed reaches, respectively.

III. PROBLEMS, NEEDS, AND DESIRES

III. PROBLEMS, NEEDS, AND DESIRES

The primary water-related problems, needs, and desires in the Red River Basin are flood control, fish and wildlife conservation and enhancement, recreation, water supply, water quality, erosion control, irrigation, wastewater management, and hydropower. Various water-related problems, needs, and desires have been identified for the Park River Subbasin in previous planning reports on the basis of analysis of conditions and public and agency comments. The list of problems, needs, and desires for the subbasin is the same as the list for the Red River Basin as a whole. Each problem is discussed separately below, with an emphasis on flooding problems.

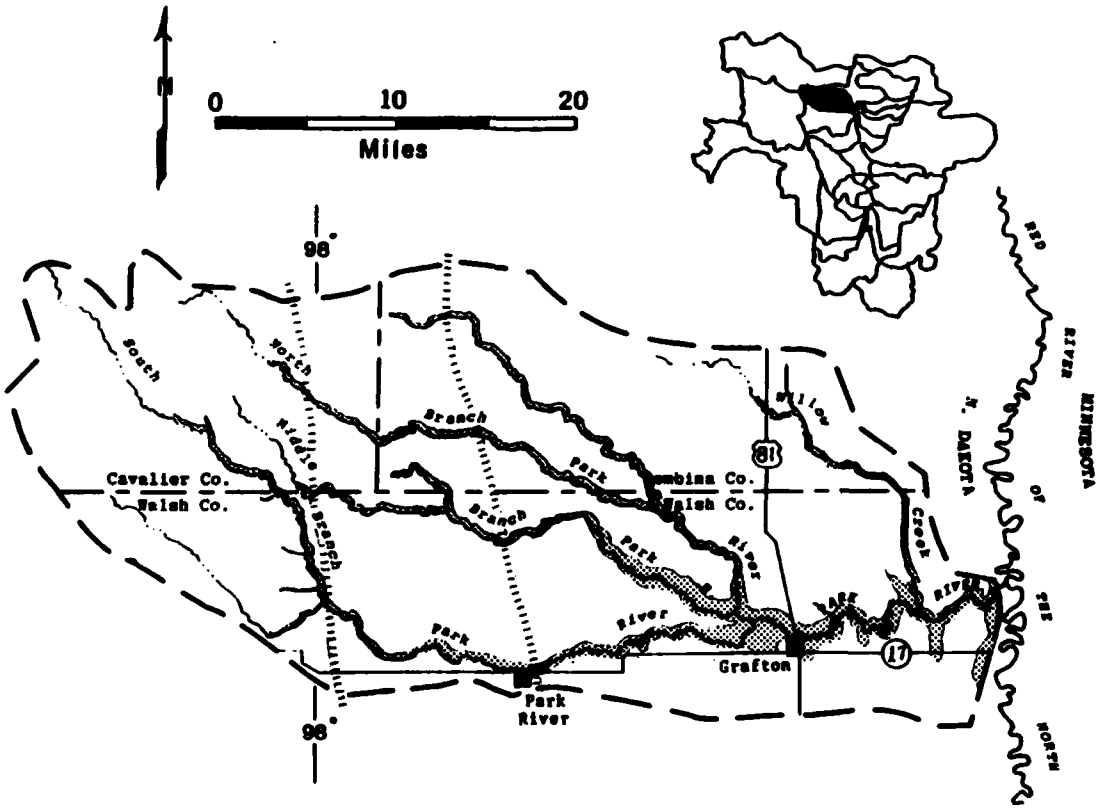
Flooding Problems

Nature of the Problems

The development of the subbasin owes much to the growth of the agricultural economy, particularly the production of wheat, sugarbeets, and potatoes in the fertile soils of the Red River valley plain. This has resulted, naturally enough, in rural floodplain encroachment. Urban encroachment, particularly in Grafton, Park River, and Crystal, can be attributed to the lack of available high ground.

Floods within the subbasin are almost an annual event. Most flooding conditions are brought about by spring snowmelt, sometimes combined with spring rains. These conditions cause delays in seeding crops which given the short growing season in this area, results in a significant reduction in yields. Moreover, the abundance of small depressions, when wet, make it impractical to operate machinery on the irregular pattern of associated dry areas. As a consequence, even minor overflow impacts much larger areas of the delineated floodplain.

Flood damage also occurs from high-intensity summer storms. Although they usually occur less frequently than spring snowmelt floods, high flows exceed channel capacity and cause damage to maturing crops. Potatoes are especially sensitive to inundation, for 36 hours of such conditions can cause a 100 percent loss. Other crops are also damaged from short periods of inundation, resulting in lower yields and poorer quality.



Source: Gulf South Research Institute.

Figure II. 100-YEAR FLOODPLAIN

Two separate types of flooding occur: the most damaging type associated with river bank overflow (overbank flooding) and another type caused by runoff from snowmelt or heavy rainfall impounded by plugged culverts and ditches within sections of land bounded by roadways on earthen fill (overland flooding). In overland flooding, the trapped water slowly accumulates until it overflows the roadways and inundates section after section of land as it moves overland in the direction of the regional slope until reaching river or stream channels.

The topography of the subbasin also influences flooding problems. The Pembina Escarpment, manifest as a range of low-lying hills, divides the subbasin into two physiographic areas, the rolling Drift Prairie to the west and the flat Red River Valley Plain to the east. Gradients of the tributaries in the uplands are generally moderately steep, with drainage to the valley plain usually very rapid. Shallow channels and diminished gradients in the latter area cause floodwaters to overflow existing channels onto the surrounding lacustrine plain, damaging cropland, farmsteads, transportation facilities, and urban areas.

Location and Extent

Figure II depicts the 100-year floodplain for the Park River Subbasin. Prior to this study, no attempt had been made to publish even a generalized delineation of the entire subbasin. A number of sources were investigated in order to produce the present delineation. Among these were: (1) U.S. Geological Survey (USGS) Flood Prone Area Maps at 1:24,000 scale; (2) Corps of Engineers photomosaics of the 1979 flood; (3) published secondary sources describing flooded areas; and (4) USGS 7½ minute topographic maps.

The map is thus a composite of available sources supplemented by inferences where necessary. Because the sources were incomplete and based on surveys differing in purpose and accuracy, it should be understood that Figure II constitutes a generalized delineation intended only for general planning purposes. A more complete description of sources and limitations is given in Appendix A.

According to this preliminary delineation, the Park River 100-year floodplain comprises a total of 38,000 acres. Major components include:

the Park River, 18,000 acres; North Branch, 6,000 acres; Middle Branch, 8,000 acres; and South Branch, 6,000 acres. No areas of associated marshland are found within the subbasin.

The Park River floodplain begins at the confluence of the North and Middle Branches and continues eastward to the Red River, including most of the city of Grafton and, for purposes of the delineation in Figure II, Willow Creek. West of Grafton, the floodplain is 2½ miles in width, narrowing to a half mile just before reaching the Red River near Interstate 29. The latter area is commonly associated with the main stem Red River floodplain and accounts for 4,000 acres of the total 18,000 acres for this segment.

The North Branch floodplain varies in width from approximately a quarter mile downward. It includes Cart Creek and virtually all of the town of Crystal and a portion of Hoople. The majority of the 6,000 acres indicated in Figure II lies in the valley plain, but the upper segments traverse the glacial outwash plain. A small segment of the North Branch emerges from the drift prairie.

The Middle Branch floodplain is similar in size to that of the North branch in the drift prairie and glacial outwash plain (comprising 2,000 acres), but widens appreciably upon entering the valley plain. Its widest point is one and a half miles, located at a point some five miles west of Grafton. The lower portion totals 6,000 acres.

Unlike both the North and Middle Branches, the South Branch extends for some 20 miles into the drift prairie. The Homme Reservoir, although located east of the Pembina Escarpment, provided a good breaking point for estimating acreage. Above the reservoir, the 100-year floodplain totals 2,000 acres, and below, twice that number.

Flood Damages

Throughout the subbasin's flood plain the following three primary areas are affected by flooding: urban, agricultural, and environmental. Grafton is the major urban center in the subbasin's floodplain. Urban and rural are the damage categories taken into account in the computation of average annual damages.

Present average annual damages in the subbasin are estimated at $2.6 million. This is one of the largest average annual damage figures for an individual subbasin, accounting for eight percent of the Red River of the North basinwide total. Average annual flood damages are divided into two basic classifications: urban and rural. Rural damages include damages to crops, other agricultural assets (fences, farm buildings, machinery, etc.) and transportation facilities. Urban damages include damages to residences, businesses (commercial and industrial) and public facilities (streets, utilities, sewers, etc.). Urban damages account for 65 percent of total average annual damages in the subbasin, and rural damages account for the remaining 35 percent.

Urban damages sustained during the flood event of 1979 totaled $5.9 million. No urban flood damages were reported to have been sustained during the 1975 flood event. The urban flood damages reported in 1979 exceeded the average annual urban flood damages of $1.7 million, by approximately 350 percent. A more detailed breakdown of these urban flood damages is presented in Table 1. Urban flood damages resulting from the 1979 flood event included $3.2 million in residential damages, $2.6 million in damages to businesses and $64,400 in public damages. Average annual urban flood damages are estimated at $846,200 in residential damages, $676,900 in business damages and $169,200 in public damages.

Table 1

PARK RIVER SUBBASIN, ESTIMATED 1979 AND AVERAGE ANNUAL URBAN FLOOD DAMAGES
(Thousands of 1979 Dollars)

	Urban Flood Damages	
Category	1979	Average Annual
Residential	$3,218.0	$ 846.2
Business	2,574.0	676.9
Public	64.4	169.2
TOTAL	$5,856.4	$1,692.3

Sources: Red River of the North Basin Plan of Study, April, 1977; Post Flood Report, 1979; and Gulf South Research Institute.

Average annual rural flood damages and the rural flood damages incurred in the 1975 and 1979 flood events appear in Table 2. Rural flood damages sustained in the 1979 flood event were nearly four times the estimated average annual damage figure, but the flood event of 1975 was not nearly as severe. Rural flood damages sustained in the 1975 flood event included $546,800 in crop damages, $364,500 in other agricultural damages and no transportation damages. The 1979 flood event included $2.2 million in crop damages, $906,000 in other agricultural related damages, and $323,000 in transportation damages. In comparison, average annual rural flood damages included $650,200 in crop damages, other agricultural damages totaling $216,800 and transportation damages of $32,500. Total average annual rural flood damages were $899,500, and rural flood damages sustained in the flood events of 1975 and 1979 were $911,300 and $3.4 million, respectively.

Table 2

PARK RIVER SUBBASIN, ESTIMATED 1975, 1979 AND AVERAGE ANNUAL RURAL FLOOD DAMAGES
(Thousands of 1979 Dollars)

	Year		
Category	1975	1979	Average Annual
Crop	$546.8	$2,203.0	$650.2
Other Agricultural	364.5	906.0	216.8
Transportation	0.0	323.0	32.5
TOTAL	$911.3	$3,432.0	$899.5

Sources: Red River of the North Basin Plan of Study, April, 1977; Post Flood Reports, 1975, 1979; and Gulf South Research Institute.

Environmental Concerns

The major problem affecting wildlife within the subbasin is past and present conversion of woodlands, wetlands, and prairie grasslands to agricultural and other uses. Most native woodlands have been eliminated or cleared to the extent that they are now confined to very narrow, linear bands along the floodplains of streams on the more level lands

of the region. In areas with relatively rugged topography, woodlands are more numerous and comprise larger acreages. However, even in some of these areas wildlife have been affected in the past by cutting for fence posts, fuel wood, and other uses and are presently affected by cattle grazing, which reduces much of the available browse and herbaceous cover beneath the forest canopy. Agricultural development has caused the drainage of most wetlands that occurred in the subbasin, as well as the tillage of most native prairie lands (Kannowski, 1971; U.S. Army Corps of Engineers, 1975; Soil Conservation Service, 1961, 1965). As indicated by the Soil Conservation Service (1980), there is a desire to maintain, restore and develop prime wildlife habitat areas and restore wetlands or prairie potholes. The same also applies for the native grasslands which were once so extensive in the subbasin and which provide excellent habitats for many species of wildlife.

Problems affecting aquatic biota include low flows, which are known to limit the fishery in the streams of the subbasin, and reduced water quality due to agricultural pollutants in runoff, municipal effluents, and channelization (U.S. Fish and Wildlife Service, 1979). In the North and Middle Branches of the Park River, moderate stresses in benthic invertebrate populations have been found, which have probably resulted from lack of suitable habitat and organic or chemical pollution (Soil Conservation Service, 1980). The U.S. Army Corps of Engineers (1975) indicated that the quality of the warmwater fishery in Homme Reservoir has been reduced because of the severe fluctuations in water level and turbid water conditions. Thus, there is a need to improve water quality in the streams and lakes of the subbasin and, where possible, to provide for flow augmentation without seriously impacting other environmental resources. The Soil Conservation Service (1980) has indicated that there is a desire for a single purpose fish and wildlife impoundment upstream from Milton with the provision of management to maintain fisheries over winter.

Recreation Problems

The subbasin is severely limited in water based recreational development because of the lack of large natural lakes in the area. Homme Lake, located several miles west of Park River, provides the only significant recreational

water resource in the subbasin, and provides the only source of moderately good sport fishing. Park River, including the North, Middle and South Branches, is limited in fishery potential by intermittent flows, agricultural runoff, the effects of previous channelization, and the discharge of municipal effluents into the river. There are only two wildlife management areas in the subbasin, totaling 419 acres.

The North Dakota State Comprehensive Outdoor Recreation Plan (1975) identifies fishing, boating, water-skiing, camping, picnicking and trails as the primary recreational needs of the planning regions that include the subbasin.

Water Quality Problems

Serious water quality problems occur on the Park River. Municipal and industrial discharges and agricultural runoff contribute heavily to these problems. The wastewater treatment problems will be discussed in a later section. Insufficient streamflows during the summer, fall, and winter result in reductions of dissolved oxgen and waste assimilation capacity, which also contribute to the water quality degradation. Natural factors adversely influencing the water quality include the release of groundwater into the surface water and releases of water from naturally occurring salt lakes. Excessive chloride and TDS levels are a result of these natural features. High sodium temperature and sulfate concentrations also occur naturally. Advanced eutrophication on Homme Reservoir also creates water quality problems (Upper Mississippi River Basin Commission, 1977; U.S. Army Corps of Engineers, 1973; North Dakota Department of Health, 1973).

The groundwater within the subbasin is of a lesser quality than the surface water. Extremely high TDS levels (<1000 mg/l) result in undesirable and inadequate water supplies in several communities throughout the subbasin. High TDS concentrations in combination with hardness cause severe scaling problems in plumbing fixtures. The groundwater supplies are also characterized by high iron and manganese levels. St. Thomas (Pembina River) trucks water into the community from another subbasin (Upper Mississippi River Basin Commission, 1977; U.S. Army Corps of Engineers, 1973).

Water Supply Problems

The communities of Park River and Grafton rely upon water from Homme Lake and the Park River for their water supply. The large water demand of Grafton, plus the losses involved in transmission of the water via the 32 miles of natural river channel, result in Homme Dam being incapable of providing Grafton with an assured water supply. The water supply problem will be compounded in the future by sediment accumulation in Homme Reservoir, which is occurring at a much higher rate than originally anticipated. The city of Park River experiences few problems with water from Homme Dam, as both the relatively small water demand of Park River and the efficient pipeline for transporting the water from Homme Dam to the treatment plant circumvent many of the problems involved in the water supply of Grafton. Because of Grafton's problems, it recently completed a pipeline to the Red River.

The surface water of the subbasin is more desirable than the groundwater; however, both require extensive treatment to meet Public Health Service drinking water standards. Saline water from deep sedimentary deposits is available, but is only acceptable for industrial needs.

Erosion Problems

Sheet scouring of isolated cultivated fields often occurs during the spring runoff season. The steeper slopes of the area experience sheet erosion, and fields lacking protective measures are damaged by wind erosion. The combined effect of sheet and wind erosion results in loss of valuable topsoil. Sediment fill of watercourses and drainage systems is also caused by wind and sheet erosion. This results in decreased water holding capacity and increased costs for maintainance and repair of natural and constructed drainage systems.

Irrigation

The irrigation of agricultural land is increasing in North Dakota. Most of this irrigation takes place along the Missouri River and its tributaries, which is west of the Red River Basin. The importance of irrigation is that the overall risk and uncertainty in farming operations is reduced when irrigation is integrated with dryland farming.

Of the almost 8,000 acres of land in the North Dakota portion of the Red River Basin for which water permits for irrigation have been issued, about 200 acres are located in the subbasin. Most of the water to be used will come from the Red River, and a very small amount will come from the Park River. However, the quality of water from deep Dakota sandstone aquifers and the Park River is not suitable for irrigation uses.

There are about 50,000 acres of land in the subbasin which have irrigation potential. These are located mainly in the beach ridge area and in the Pembina delta area in the central and north-central portions of the subbasin. The demand for irrigation of these lands, however, has not been great and is not expected to increase in the near future.

Wastewater Management Problems

Serious water quality problems are a result of municipal and industrial effluent discharges and agricultural runoff. Intermittent streamflows compound the problems of the point source dischargers. Sufficient flows occur only during the spring floods, at which time discharges into the river are allowed. At other times, the low flows reduce the river's assimilative capacity so that waste discharges into the river during these periods will cause violations of the water quality standards. However, waste water is occasionally released into the river when the treatment lagoons become full and further retention is impracticable (U.S. Army Corps of Engineers, 1973; Upper Mississippi River Basin Commission, 1977). Table 3 presents the existing treatment facilities and needs of ten communities within the subbasin.

Hydropower

The two existing dams in the subbasin were constructed for flood control purposes on the Middle Branch Park River. These sites have been identified by the U.S. Army Corps of Engineers' Institute for Water Resources as small-scale facilities with minimal potential for hydropower development. At least three other sites in the subbasin were studied for possible hydropower use, but were found to be either of minimal potential for development or were not economically feasible.

Table 3

WASTEWATER TREATMENT AND NEEDS OF TEN COMMUNITIES
WITHIN THE PARK RIVER SUBBASIN

Community	Population Served	Design Flow (MGD)	Actual Flow (MGD)	Type Treatment	Surface Area (Total Acres)	Needs or Comments
Adams	284	0.045	0.018	Secondary	7.0	--
Crystal	272	0.037	0.018	Secondary	5.0	Reline existing cell
Edinburg	315	0.041	0.020	Secondary	5.5	Construct new lagoon
Grafton	5,946	0.459	0.387	Secondary w/aereation	142.25	Inadequate
Hoople	330	0.042	0.021	Secondary	5.7	--
Milton	198	0.030	0.018	Secondary	4.0	Reline existing cell
Mountain	146	0.034	0.010	Secondary	4.5	--
Osnabrock	255	0.026	0.016	Secondary	3.5	Construct new lagoon
Park River	1,680	0.196	0.109	Secondary w/aereation	31.0	Raise dikes on 2 lagoons
St. Thomas	508	0.053	0.033	Secondary	8.5	Inadequate

Source: North Dakota State Department of Health, 1978;
Shewman and North Dakota State Department of Health, No date;
Upper Mississippi River Basin Commission, 1977.

Public Perception of Problems and Solutions

The public's perception of problems and solutions in the subbasin has been reasonably well defined by the Corps of Engineers as a result of studies and public meetings conducted in this area. Also, the subbasin has been organized into watershed districts which demonstrates a recognition of problems and need for solutions.

The primary document for the identification of public perceptions is a 1971 study perfomed by the University of North Dakota for the Corps of Engineers entitled: Social and Economic Considerations for Water Resources Planning in the Park River Subbasin. In the chapter devoted to social factors, the authors discuss general environmental and outdoor recreationists' attitudes, the public image of the Corps of Engineers, and the public's perceived water control needs. The latter section is particularly relevant to the task at hand.

A detailed survey of the area residents was conducted to ascertain local perception of problems and solutions. Persons were interviewed in the communities of Grafton and Park River as well as in rural areas in the subbasin. An additional survey was also made of community leaders. The question of public perception was approached from the standpoint of: (a) the public's need for Corps-sponsored watershed projects; and (b) the need for water control benefits of flood control, stable water quality, and additional recreation facilities.

Roughly half of the respondents indicated that it was of personal concern whether the proposed flood control projects were approved or not. Community leaders, when separated from the other respondents, indicated that the project made significantly more difference to them than the balance of others surveyed.

Location also made a difference as to how meaningful the project was to the individuals affected by it. Reasons why rural residents below the Homme Dam and Grafton residents attached greater importance to the considered projects is partially attributed to the fact that these residents were more closely associated with the river's past problems and operation of the Homme Dam.

Respondents were also asked what they perceived the need to be for the major benefits of the Corps' water control plans. When asked whether they thought there was a need for flood control, 66 percent responded definitely and 27 percent said probably. The question of whether there was a need for water supply produced similar results, 68 percent saying definitely and 19 percent responding probably. Although not as strong as the above items, support was evidenced for water based recreation.

Additional evidence for interest in flood control measures is contained in public hearings held in East Grand Forks in 1978 and 1979 before subcommittees of the Committee on Public Works and Transportation of the U.S. House of Representatives. From these documents, it is evident that most residents of the Red River Basin consider flood control to be the primary water related need for the area and that they are interested in whatever solutions may be proposed by Federal, state, or local agencies.

IV. DESCRIPTION OF SUBBASIN RESOURCES

IV. DESCRIPTION OF SUBBASIN RESOURCES

This section of the report discusses the primary resource conditions within the subbasin that are water-related and that would be affected by a comprehensive water and related land resources plan centering on flood control measures.

Social Characteristics

For the thirty years prior to 1970, the population of the subbasin slowly but steadily decreased. This decline can be attributed to the migration of people from farms and small towns to urban areas where employment opportunities are greater. Between 1970 and 1977, the subbasin's population increased slightly (2.3 percent), from 13,867 to 14,192. Each of the three counties (Cavalier, Pembina, and Walsh) within the subbasin increased during the 1970's. Pembina and Walsh counties experienced a natural increase, and their immigration rates were less than one percent. Cavalier County's increase in population was the result of a natural increase and an immigration rate of 5.4 percent.

The two largest towns are Grafton and Park River, and they are both located on the Park River. Grafton's population increased by 20 percent each decade between 1940 and 1960. This trend changed during the 1960's, and the increase was only one percent between 1960 and 1970. By 1977, Grafton's population had decreased from 5,946 in 1970 to a figure of 5,798, which was a 2.5 percent decrease. The population of Park River has shown an overall increase since 1940, even though it decreased between 1960 and 1970. The 1977 population was 1,851, which was 10 percent higher than the 1970 population of 1,680. The other towns in the subbasin are very small, with populations under 600.

The population density for the subbasin increased from 13.7 persons per square mile in 1970 to 14.1 persons per square mile in 1977.

Almost half (45 percnet) of the populations in Cavalier and Pembina counties are of Canadian origin, and Norwegian is the dominant ethnic group represented in Walsh County.

Communities in the subbasin are fairly stable, as can be seen by home ownership, length and place of residence, and place of employment. Most of the subbasin's population is in Walsh County. Almost 79 percent of the 1970 Walsh County population owned their homes. Census figures show that 71 percent had lived in the same house since 1965, and 88 percent lived in the same county. Also, 71 percent of employed persons lived and worked in the same county. Approximately 78 percent of the Pembina and Cavalier county residents owned their homes. Sixty-eight percent occupied the same residence since 1965 in Pembina County and 89 percent lived in the same county, while 71 percent of the Cavalier residents lived in the same house in 1965, and 91 percent lived in the same county. Approximately 88 percent of the Pembina population and 83 percent of the Cavalier population worked in the county of residence.

Economic Characteristics

Employment

Between 1950 and 1970, agricultural employment in the subbasin decreased by more than 50 percent. This can be attributed to increased farm mechanization and increased acres per farm unit due to consolidation. Employment in other sectors did not increase enough to offset the decline in farm employment, and the result was a decrease in total employment. Agricultural employment was more stable during the 1970's, and other sectors continued to increase. The result was an increase in total employment from 4,853 in 1970 to 6,954 in 1977, which was a 43 percent increase. Unemployment averaged about 6.5 percent.

Farming still contributes more to the economy of the subbasin in terms of both employment and income than any other industry. It is expected to continue as the main economic base for the subbasin in the years ahead.

Income

Total personal income for the subbasin increased from $72 million to $85 million between 1969 and 1977 (expressed in 1979 dollars). Farm income accounts for more than 70 percent of the total personal income, and cash grain sales amount to three-fourths of the total farm income.

Average per capita income during the same years increased 14.8 percent from $5,187 to $5,957, which was 14 percent lower than the 1979 average income figure of $6,859 for the state of North Dakota which rose 21.9 percent during this period. Although there has been an upward trend in both total personal and per capita income, fluctuating farm prices are the primary determinants of income changes from year to year. Severe flooding, as in 1975, can also cause sharp declines in income.

Business and Industrial Activity

Agriculture

Agriculture is the predominant sector in the subbasin's economy, and the production of small grains is the most important agricultural component. Approximately 78 percent (or 504,192 acres) of the subbasin's land area is under cultivation, and another eight percent is devoted to pasture. Livestock production is not as important in the subbasin as in other parts of northeastern North Dakota.

The major crops grown in the subbasin are identified in Table 4. Wheat is the leading crop, accounting for 47 percent of the harvested acreage. This is followed by barley (25 percent), sunflowers (10 percent), potatoes (six percent), hay (five percent), sugarbeets (four percent), and oats (two percent). There are also minor acreages of rye and flax. The northeast part of the subbasin (Pembina County) was ranked tenth among the counties in North Dakota in 1978 in the production of sunflowers. All three counties within the subbasin (Pembina, Cavalier, and Walsh) ranked in the top 10 counties in barley production that year, and Cavalier and Walsh were leading producers of all wheat.

The eastern half of the subbasin is more than 70 percent prime farmland, which has the most productive soils in the subbasin. The area is devoted to growing small grains, sunflowers, potatoes, soybeans, sugarbeets, and pinto beans. The central part of the subbasin is planted in small grains, sunflowers, and flax, and there is an important acreage of woodlands and pastureland. The western part of the subbasin is primarily used for growing small grains, sunflowers, potatoes, and corn, and a small portion to the northwest grows flax, grasses, and legumes. This area also has native grass rangelands.

Table 4

1978 CROP STATISTICS, PARK RIVER SUBBASIN

Crop	Harvested Acres	Yield Per Acre	Total Production
Wheat	202,900	34 bushels	6,898,600
Barley	107,230	47.6 bushels	5,104,148
Sunflowers	41,360	1,397 pounds	57,779,920

Source: Gulf South Research Institute.

The floodplain is primarily under cultivation, with an emphasis on wheat, sunflowers, potatoes, soybeans, and sugarbeets.

Manufacturing

Of the 83 manufacturing establishments in the subbasin, more than 80 percent directly support the agriculture industry. Approximately 63 percent of the total establishments store or process potatoes, an important crop in the subbasin. Most of the towns in the subbasin have potato warehouses or plants. The subbasin is an agricultural center that provides important services to surrounding subbasins. Employment in manufacturing has increased slightly since 1960. In 1977, the number of people in the subbasin employed in the manufacturing sector was approximately 15 percent of the total employment. The manufacturing establishments are identified in Table 5 according to their Standard Industrial Classification (SIC) numbers. Most of the manufacturers employ a small number of people.

Trade

In 1977, total trade receipts for the subbasin exceeded $135 million (expressed in 1979 dollars). More than 65 percent (or $88.7 million) of the receipts were wholesale trade. Retail trade and selected service receipts were $46.6 million and $5.5 million, respectively, in 1977.

Transportation Network

The subbasin is crossed from north to south by State Highways 32 (through Mountain and Edinburg) and 18 (near Hoople), and by U.S. Highway 81,

Table 5

MANUFACTURING ESTABLISHMENTS, PARK RIVER SUBBASIN

SIC	Description	Estimated Employment
14	Mining of Nonmetallic Minerals	18
17	Construction-Special Trade Contractors	9
20	Food and Kindred Products	100
27	Printing and Publishing	30
32	Stone, Clay, Glass, and Concrete Products	18
35	Machinery, except Electrical	56
42	Motor Freight Transportation/Warehousing	65
51	Wholesale Trade	95
54	Food Stores	45
TOTAL		1,036

Source: 1978-1979 Directory of North Dakota Manufacturing.

which runs through St. Thomas and Grafton. Each of these highways intersect east to west routes 17 (through Park River and Grafton) and 66 (through Crystal), which travel east and connect to I-29. Interstate 29 provides access out of the rural subbasin into the city of Grand Forks, which is an important service center for many of the subbasins. Highway 81 can also be used to travel to Grand Forks. All of the major highways and some county roads cross the Park River and may be subject to flooding.

The Burlington Northern Railroad has four rail lines which pass through many of the towns in the subbasin and provide access into Grand Forks. There are municipal airports located at St. Thomas, Grafton, and Park River. These are small airports with limited facilities. A natural gas pipeline crosses the subbasin near Edinburg and serves Park River and Grafton.

Land Use

Approximately 78 percent of the subbasin is under cultivation, 8.4 percent is forest, 8 percent is pasture, and 3.6 percent is urban development. Water areas account for only two percent of the total land area.

Land use in the floodplain of the Park River does not differ significantly from land use in the subbasin. The floodplain is an important agricultural area, and there are significant forest acreages along the river in the west-central portion of the subbasin.

Environmental Characteristics

Climate

Weather stations for the subbasin are located at Grafton and Park River. The climate of the subbasin is characterized by variations in temperature and moderate amounts of rainfall and snowfall. Mean monthly temperatures vary from 70°F in the summer to 4.3°F in the winter. The maximum recorded temperature is 108°F and the minimum is -42°F. The average date of the last killing frost is May 20, and the earliest is September 19, with an average growing season of 122 days. However, the long hours of summer sunshine in this latitude make it possible to grow and mature many different crops. The average annual precipitation is 17.4 inches. The mean annual snowfall at Park River is 34.8 inches, which is equivalent to approximately 3.5 inches of precipitation. In most years, snowmelt runoff causes damaging floods during March, April, or May. Damaging floods caused by excessive rainstorms occur mainly during the months of June, July, August, and September.

Geology

The subbasin is located within the Central Lowlands Province of the Interior Plains physiographic division. Bedrock is predominantly undifferentiated ordovician deposits of limestone and dolomite with a shale and sandstone base overlain by Cretaceous sediments of shale and limestone and sandstones of the Colorado and Dakota groups. Glacial sediments include clay and silt lake deposits occupying the eastern half of the subbasin and till composed of clay, silt, sand and gravel in the western portion. The Pembina Escarpment forms the approximate boundary between these two areas. Holocene alluvium silt and fine sand outwash deposits are found along the floodplains of the Park River branches and tributaries.

Biology

The potential natural vegetation of the subbasin includes the Northern Floodplain Forest along the Red River and Park River floodplain in the Agassiz Lake Plain and Northeastern Drift Plain of the Prairie Pothole Region. Bluestem Prairie occurred in the eastern grassland area and Wheatgrass-Bluestem-Needlegrass Prairie in the western part. Agricultural development has eliminated or altered much of these native communities so that little of the potential vegetation exists today. Characteristic prairie vegetation is confined primarily to roadsides, railroad rights-of-way, fence lines, deforested river banks and slopes, abandoned farmland, country churchyards and cemeteries, and some grassland pastures (Kuchler, 1964; Kannowski, 1971; Stewart, 1975; U.S. Army Corps of Engineers, 1975).

Most woodlands have been cleared or at least diminished from their former extent in the uplands and along stream floodplains. They are now found as narrow riparian communities along streams or around lakes, in upland areas where the rugged terrain has prevented total conversion of the lands to either cropland or pasture, and as shelterbelts or windbreaks. Kannowski (1971) investigated the plant resources of the South Branch and Main Stem of the Park River in Walsh County northeast of Adams and around the Grafton area. Generally, bur oak was found as the dominant overstory species on river slopes and in small areas in the oak savanna that occupy the glacial drift upland above the river slopes. Other trees found in association with this species on the river slopes included aspen, boxelder, green ash, and some paper birch. Common shrub species include snowberry, beaked hazel, chokecherry, high-bush cranberry, and Juneberry. Herbaceous plants consisted of Pennsylvania sedge, arrow-leaved aster, goldenrod, early meadow rue, and grasses. Along the floodplain, American elm, boxelder, basswood, green ash, cottonwood, aspen, willow, and bur oak were the common tree species. Periodic flooding and shading of the overstory appeared to prevent a well-developed shrub layer, which was represented by species such as chokecherry, gooseberry, and prickly ash. The light herbaceous cover was comprised of Pennsylvania sedge, meadow rue, carrion flower, nettle, violets, and grasses.

Farmer et al. (1974) conducted an environmental impact assessment of the Homme Reservoir area on the South Branch of the Park River west of Grafton. A vegetation survey was conducted in the reservoir area during the summer of 1974 in which 361 vascular plant species were identified. Eight communities were described, which are presented below.

1. Boxelder--paper birch community. This community encompasses nearly 100 percent of the southern shore of the reservoir and is dominated by boxelder; paper birch is found on the steeper slopes. Common associates include green ash, Americal elm, and bur oak. The overstory is fairly diverse, ranging between 12 and 15 meters. The shrub layer is also fairly dense and dominated by Juneberry, green ash, and ironwood. The herbaceous layer is moderately sparse.

2. American elm--Boxelder community. This community occupies much of the north shore of the reservoir and is found on the north bank of the river downstream from the dam. American elm is the principal tree species, with boxelder and bur oak as common associates. The overstory is fairly diverse and varies between 12 and 15 meters. The shrub stratum is very dense with chokecherry. The herbaceous layer is relatively sparse.

3. Boxelder--basswood community. This community occupies the south bank of the river below the dam. Boxelder is dominant while basswood and American elm are frequent subdominants. The canopy is relatively open with tree heights varying from 12 to 15 meters. Both the shrub and herbaceous layers are sparse.

4. Green ash--bur oak community. This community is found near the west end of the north shore of the reservoir where green ash occupies most of the overstory that ranges from 12 to 15 meters. Bur oak is the only other tree in the overstory. Boxelder and American elm are the major species in the patchy shrub stratum. The herbaceous layer is very dense.

5. Aspen--American elm community. This community also occupies the area near the green ash-bur oak community. The overstory, dominated by the two species, attains heights of 10 to 12 meters. There is a dense shrub layer of Juneberry, green ash, beaked hazel, and viburnum; the herbaceous layer is moderate in coverage.

6. Cattail community. Found on the western end of the reservoir, this community is composed of broad-leaved and narrow-leaved cattail. Reed-canary grass is found in some areas.

7. Brome grass community. Smooth brome grass, alfalfa, and crested wheatgrass are the dominant taxa in this planted community, located south of the spillway.

8. Shelterbelts. This is an area of planted trees and shrubs in the croplands around the reservoir that serve to reduce wind erosion of soils in the fields. Species found in this community included green ash, caragana, lilac, Kentucky bluegrass, and smooth brome grass.

Most of the wetlands in the subbasin have been eliminated, except for some prairie potholes remaining in the western portion of the subbasin that have been difficult to drain. Limited marsh areas, such as the cattail community described above for the Homme Reservoir, probably occur around the perimeter of lakes. Wetland types known to occur in Pembina, Walsh, and Cavalier counties include the following: Type 1--seasonally flooded basins or flats; Type 3--shallow fresh marshes; Type 4--deep fresh marshes; and Type 5--open fresh water (U.S. Army Corps of Engineers, 1975; U.S. Fish and Wildlife Service, 1979).

Important wildlife habitats in the subbasin are the remaining woodlands, wetlands, and grasslands. The woodlands and brushy areas provide den and nesting sites, territories, winter and escape cover, and winter food for many resident and migratory species in the region. They also furnish a travel corridor for animals moving back and forth between the Red River and the western areas of the subbasin. Forests afford breeding and nesting areas for birds and rank second only to wetlands in breeding bird populations, with 336.0 pairs/Km^2. They also provide an important ecotone or "edge" with adjacent habitats such as grasslands, agricultural lands, and aquatic habitats, and in such cases, will contain wildlife representative of the other bordering habitats. Woodlands contain a greater variety of wildlife species than any other major habitat type found in the subbasin. Wetlands furnish breeding, nesting, feeding, and resting areas for waterfowl; breeding and rearing habitat for big and small game, furbearers, and other wildlife such as wading and passerine birds; spawning and nursery areas for fishes and aquatic invertebrates; and a high-yield food source for many resident species. They rank first in breeding bird densities with 337.0 pairs/Km^2. The native grasslands or prairie, when found in

combination with wetland complexes, form a dynamic and diverse ecosystem which supports diverse and abundant populations of birds, mammals, invertebrates and plants. Average breeding bird densities of 142.7 pairs/Km^2 have been recorded in this highly productive community. Because of their importance as habitats for wildlife and the limited areal extent of these communities within the subbasin, there is a need to protect, conserve, and enhance, these areas wherever possible (U.S. Fish and Wildlife Service, 1979, 1980; U.S. Army Corps of Engineers, 1975).

The principal big game animal of the subbasin is the white-tailed deer. Population levels are highest (1.5 deer/square mile) along the Red River and along most of the main stem and tributaries to the Park River. Densities become moderate (0.5-1.5 deer/square mile) in the north-central part of the subbasin in Pembina County. Moose may occur periodically, with populations varying between 0.05 to 0.15 moose/square mile. Waterfowl production is generally in the eastern part, with <4.0 breeding pairs/square mile, and medium in the upper reaches of the subbasin, with 4.0-9.0 breeding pairs/square mile. The most common breeding waterfowl are the mallard, blue-winged teal, pintail, gadwall, and northern shoveler. During migration, Homme Reservoir and Salt Lake and North Salt Lake are some of the waterbodies used by waterfowl. Wood duck production recurs to some extent along the Park River in the floodplain woodlands.

The Hungarian partridge is the major upland game bird; population densities are high in the subbasin, with 32-60 birds/1,000 miles of rural mail carrier route. Sharp-tailed grouse and pheasant populations are generally low throughout the region, with densities of <3.0 sharp-tails/square mile and <1.0 pheasant hens/square mile. Common furbearers are the muskrat, red fox, beaver, mink, raccoon, skunk, and weasel. In the eastern part, red fox populations are moderately low at 5.0-8.9 families/township, while in the western portion they are moderately high, with 9.0-13.0 families/township (data from North Dakota Game and Fish Department in U.S. Fish and Wildlife Service, 1979; Farmer et al., 1974; Soil Conservation Service, 1964; Kannowski, 1971). Table 6 presents harvest data from 1970-75 for many of the species mentioned above within Walsh and Pembina counties.

Table 6

HARVEST DATA FOR GAME AND FURBEARING ANIMALS IN PEMBINA AND WALSH COUNTIES, PARK RIVER SUBBASIN

Species	Number Harvested[a]											
	1970		1971		1972		1973		1974		1975	
Red fox (Trapped and Hunted)	82	(117)	639	(745)	516	(650)	1,396	(1,721)	632	(805)	732	(996)
Coyote (Trapped and Hunted)	--	--	--	--	--	--	--	--	--	--	7	(2)
Sharp-tailed grouse	558	(670)	1,249	(625)	454	(454)	473	(947)	241	(241)	619	(333)
Ring-necked pheasant	-0-	(-0-)	-0-	(-0-)	-0-	(185)	-0-	(75)	-0-	(141)	33	(132)
Cottontail	614	(2,105)	674	(707)	587	(991)	939	(1,033)	175	(913)	562	(1,765)
White-tailed deer	298	(147)	567	(412)	465	(336)	488	(461)	300	(297)	294	(305)
Hungarian partridge	907	(3,175)	2,290	(2,163)	1,508	(2,369)	4,575	(4,702)	960	(2,793)	625	(2,065)
Fox Squirrel	1,120	(3,812)	507	(1,911)	2,058	(3,394)	1,798	(2,750)	1,470	(3,414)	1,834	(2,999)

[a]Numbers in parenthesis are for Walsh County; those outside of parenthesis are for Pembina County.

Source: North Dakota Game and Fish Department in U. S. Fish and Wildlife Service, 1979.

A total of about 273 species of birds have been identified from Pembina, Walsh, Grand Forks, and Nelson counties in northeast North Dakota. Two hundred and sixty-seven (267) species have been reported as possibly occurring at the Homme Reservoir site; observations were made of fifty-four species. Northeast of Adams in the subbasin, 45 species of birds have been recorded, including both migrants and residents. Approximately 168 species of birds may breed in the various habitats of the subbasin, including the killdeer in croplands, western meadowlark in grasslands, brown thrushes in thickets, marsh hawk around wetlands, and great horned owl in woodlands. About 31 nongame mammals have been identified from the four-county area mentioned above. Nongame mammals reported from the subbasin include species such as the Franklin ground squirrel, flying squirrel, pocket gophers (species unknown), Gapper's redback vole, meadow vole, white-footed mouse, deer mouse, and meadow jumping mouse. Amphibians are represented by nine species and reptiles by seven species. Common herpetofauna include the tiger salamander, Dakota toad, wood frog, painted turtle, and plains garter snake (Farmer et al., 1974; Kannowski, 1971; Stewart, 1975; Willis, 1977).

Kannowski (1971) identified 62 families of insects, representing 12 orders, from a forest in the subbasin. Taxonomy was to the family level, with the exception of ants in the family Formicidae (Hymenoptera), where a total of 19 species were identified.

The North and South Branches and the main stem of the Park River have been classified by the U.S. Fish and Wildlife Service and North Dakota Game and Fish Department as Class III streams. This designation means that these streams support a substantial fishery resource. Moderate forage and sport fish production is provided by these reaches. In addition, these reaches provide the water supply for reservoirs and municipalities in the area. Without the fishery resource, the streams would possibly have been given a lower evaluation due to the intermittent flows and poor water quality caused by agricultural runoff, channelization, and municipal effluent. The Middle Branch Park River and Cart Creek, a major tributary to the North Branch, were both classified as Class IV streams, which means that these reaches have only a very limited fishery resource. Because of extended periods of intermittent flows, channelization, and agricultural runoff, these reaches provide no sport fisheries and a limited forage fish production.

Game fish that are common to the Park River and its tributaries include northern pike, crappie, yellow perch, and channel catfish. The common shiner, fathead minnow, creek chub, white sucker, brook stickleback, Johnny darter, and blackside darter are rough and forage fishes that are commonly found within the subbasin. The northern red belly dace and trout perch are considered to be rare in North Dakota. Both were reported from the subbasin by Copes and Tubb (1966). The Homme Dam provides a moderate sport fishery for walleye, bluebill, northern pike, and crappie (U.S. Fish and Wildlife Service and North Dakota Fish and Game Department, 1978). Cvancara (1970) reported three mussels from the Park River. However, only one of these, Anodontoides ferussacianus, was represented by live specimens. The other two, Anodonta grandis and Lampsilis siliquoidea, were represented by empty shells.

Water Supply

The Pierre shale, in the western region, yields highly mineralized water. Seeps and springs in the valley suggest that some of this water reaches the South Branch of Park River. Water of better quality is found in several glacial drift aquifers.

Water supply sources in the subbasin are adequate to meet present and future needs, except Homme Lake and Park River, which are considered inadequate to meet the needs of Grafton. Both the cities of Grafton and Park River rely on the South Branch of the Park River as a supply source. The North Dakota State Department of Health records show that Grafton uses approximately 273,750,000 gallons per year, and Park River uses about 75,190,000 gallons. The communities of Grafton and Park River depend on Homme Lake and the Park River for their source of water supply. The city of Park River also uses some groundwater to supplement the supply from Homme Lake. Other communities in the subbasin rely mainly on groundwater. Industrial water consumers use the saline water from the bedrock aquifers. Because of its water supply problems, Grafton recently completed a pipeline to the Red River.

Water Quality

The North Dakota State Department of Health has classified the Park River and its major tributaries (with the exception of the South Branch) as Class III streams. These streams all have low average flows and

generally prolonged periods of no flow. This characteristic, in combination with poor water quality, impairs these reaches for a variety of uses such as irrigation, municipal water supply, fish and wildlife propagation, and water based recreation. As was discussed in the Problems and Needs section, several parameters consistently create problems. Excessive TDS, sulfates, chlorides, and sodium concentrations are caused by natural features, such as recharge of surface water from groundwater sources and natural lakes containing high salinity water. Neither the groundwater nor the surface water quality meets the Public Health Service's recommended standards for potable water supplies (U.S. Army Corps of Engineers, 1973; Shewman and North Dakota State Department of Health, no date). Table 7 presents water quality data for two of the major tributaries of Park River.

Table 7

WATER QUALITY DATA FROM TWO MAJOR TRIBUTARIES WITHIN THE PARK RIVER SUBBASIN

Parameter	Standard[1]	Middle Branch Near Union		Cart Creek At Mountain	
		Minimum	Maximum	Minimum	Maximum
Streamflow (cfs)	--	0.20	--	0.21	260
pH (standard units)	6-9	7.6	8.4	7.6	8.3
Temperature (^{o}C)	32	0.0	21.5	0.0	20.5
Hardness ($CaCO_3$)	--	44	220	83	440
Sulfate	--	12	98	51	260
Chloride	250 mg/1	6.4	26	8.3	23
Fluoride	--	0.1	0.5	0.1	0.5
Total Dissolved Solids (TDS)	1,000	105	419	165	665
Nitrates (N)	5.0	--	--	0.14	--
Phosphates (P)	0.2	--	--	0.13	--
Iron (mg/1)	--	40	430	0	490

Note: Unless otherwise stated, all units of measure are mg/1.

[1]From Shewman and North Dakota State Department of Health, No date.

Source: U. S. Geological Survey, 1979.

Although the aquifers within the subbasin normally yield adequate amounts of water, the quality is usually unfit for drinking purposes. Some aquifers produce water with TDS concentrations of 20,000 mg/l, which is unfit for any use. Excessive levels of iron, manganese, and hardness also degrade the groundwater quality within the subbasin (Farmer et al., 1974; Upper Mississippi River Basin Commission, 1977). Table 8 gives the water quality data for three wells near Homme Reservoir.

Table 8

WATER QUALITY DATA FOR THREE WELLS NEAR HOMME RESERVOIR, PARK RIVER SUBBASIN

Parameter	Well Number 157-56-23-DAC	157-56-23-DBB	157-56-24-ABB
Silica	27	25	25
Calcium	281	192	103
Magnesium	47	47	26
Sodium	14	33	3.9
Potassium	4.7	5.6	3.1
Bicarbonate	521	418	319
Sulfate	495	373	89
Chloride	3.4	15	-0-
Fluoride	0.4	0.2	0.6
Nitrate	-0-	-0-	9.6
Dissolved Solids (Residue)	1,180	914	414
Hardness (Ca,Mg)	897	671	364
Boron (mg/l)	50	150	-0-
Iron, Total (mg/l)	4,400	5,400	-0-

Note: Unless otherwise stated, all units of measure are in mg/l.

Source: Farmer et. al., 1974.

Aesthetics

Most of the lands in the subbasin have been cleared for agricultural use; however, there is a degree of topographic variation in the subbasin, particularly in the escarpment area, that provides visual relief from featureless agricultural plains. Forested lands are especially limited in North Dakota, and the wooded corridors currently present along the South Branch and main stem Park River provide areas of wildlife habitat and aesthetic appeal that will become very scarce if the practice of clearing woodlands for agricultural purposes continues.

Homme Lake and recreation area provides the only large body of water and associated water-based recreational opportunities in the subbasin. This area receives heavy recreational use throughout the year and provides an aesthetically pleasing area for the enjoyment of subbasin residents.

Poor water quality as a result of intermittent flow, channelization projects, agricultural runoff and municipal effluent has detracted from the aesthetic appeal of the main stem and the various branches of the Park River.

Cultural Elements

A series of glacial beach ridges, or strandlines, associated with the formation of glacial Lake Agassiz bisect the western half of the subbasin. These beach ridges, in combination with the Pembina Escarpment, separate the drift prairie from the flat plains of the Red River Valley. Beach ridges tend to be probable locations for prehistoric sites. Systematic archeological research in the subbasin has focused upon site-specific locales along the Middle and South branches of the Park River, i.e., the Homme Dam Reservoir (Farmer et al., 1974; Loendorf and Loendorf, 1975; Kannowski, 1971). Thus, our archeological knowledge of the subbasin is somewhat limited to the riverine ecosystem.

As a permanent source of water supply, the Park River and its tributaries were favored by large-game animals and humans, alike. The river was reportedly named by early explorers for the "buffalo parks" along the stream. The "parks" were actually corrals constructed by Indians along the river to entrap, or perhaps stampede, buffalo herds over the bluffs (WPS, 1950:186). Thus, while previous investigations here, and along

the Forest River, have shown few if any indications of occupation sites immediately along the stream banks, buffalo killsites are always a possibility. Campsites, however, are often disturbed or destroyed by agricultural development (see Kannowski, 1971:48).

Woodland mound sites are relatively prominent, but poorly understood, archeological features in the subbasin, and in the whole of eastern North Dakota as well. The greater reported incidence of Woodland mounds is probably attributable, at least in part, to their greater surface visibility. For the most part, the villages that might have been associated with mound complexes have gone undetected and undocumented by researchers. Many sites identified in previous surveys along the Park River were located on bluffs or river terraces (Farmer et al., 1974:40). This spatial pattern appears to be particularly true of Woodland mounds (Wedel, 1961:216; Cole, 1968). The location of known archeological resources along elevated portions of the river could help to minimize the possible effects of flood control alternatives; but, on-site surveys would be necessary to verify if this is true in all cases.

Historically, the subbasin was inhabited by the Yanktonai Dakota Indians and perhaps also by the Plains Chippewa (Robinson, 1966:24-26). The Red River ox-cart trail from St. Paul to St. Joseph (now Walhalla, ND) is known to have traversed the subbasin as early as 1801. Two small undisturbed segments of the trail remain at a ford of the Park River (Kannowski, 1971:49). The development and expansion of transportation networks, particularly the railroads, gave new impetus to organized settlement in North Dakota during the 1870s-1890s (Robinson, 1966:144-146). Many of the homesteaders were of Canadian and Norwegian descent, and their impact still remains upon the landscape. There is one site listed on the National Register of Historic Places, and none are nominated to its rolls. Systematic literature reviews and on-site surveys are needed to verify historical and archeological sites. At that time, their potential significance can be assessed and their eligibility to the National Register of Historic Places can be determined.

Recreational Resources

Recreation resources are severely limited within the subbasin. There are approximately 1,391 acres of recreational acreage in the subbasin.

Most of the recreation sites larger than 15 acres are concentrated in the central portion, as is illustrated in Figure III. These sites represent 92 percent of the recreational lands in the subbasin. An inventory of illustrated sites is included in Appendix B of this report.

There are only two wildlife management areas in the subbasin, comprising a total of 419 acres. Species found in the area include waterfowl, shorebirds, upland game birds, deer, furbearers, and nongame birds.

Homme Lake, located 17 miles west of Grafton, provides the only significant fishing resource in the subbasin. Walleye, bluegill, northern pike and crappie are present in moderate quantities. Homme Dam receives heavy recreational use attracting an estimated 90,000 visitations in 1972. Other recreational facilities in the subbasin are generally limited to municipal and school parks and athletic fields. No proposed sites have been identified in the subbasin.

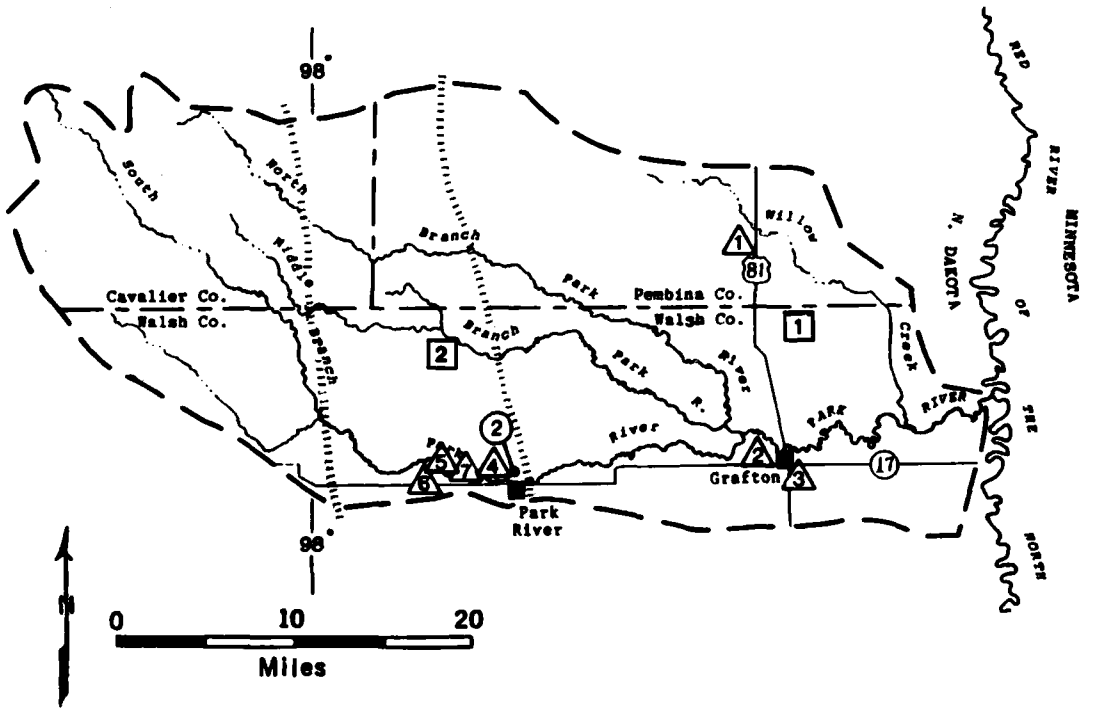
Significant Environmental Elements

Social

Grafton and Park River, which are both located in Walsh County, are the population centers of the subbasin. The other towns are very small, with populations under 600. The Soil Conservation Service and Corps of Engineers have constructed several projects in the subbasin, including Homme Dam. As a result of the implementation of flood control measures, the town of Grafton and agricultural lands in the valley are the remaining areas subject to flooding problems. The town of Grafton is affected by flooding, causing damages to local residences and commercial establishments, transportation arteries and utilities. Problems may occur with municipal water supply and sewage systems. In addition, towns that serve as agricultural service centers may experience losses to the local economy because of losses incurred by the farmers as a result of flooding problems. Damages to agricultural lands include the loss of soils, loss of crops or reduced yields, delays in planting, and costly repairs to farm structures or equipment.

Cultural

Archeological surveys of selected portions of the Park River have indicated a relatively extensive prehistoric occupation of the riverine area.



□ EXISTING WILDLIFE AREAS

1 North Salt Lake WMA
2 Charles C. Cook WMA

△ EXISTING RECREATION AREAS

1 St. Thomas Park
2 Grafton Park
3 Grafton Outdoor Recreation Complex
4 Walsh County Gun Club
5 Spillway Overlook
6 West Bay Landing
7 Homme Dam and Recreation Area

○ OTHER EXISTING RECREATION AREAS

1 Grafton Golf Course
2 Park River Golf Club

Source: Gulf South Research Institute.

Figure III. RECREATIONAL RESOURCES

Many of these sites are earthern mounds which are significant, but poorly understood, archeological features in eastern North Dakota and throughout the northern plains. The small undisturbed portion of the Red River ox-cart trail which traverses the subbasin is a significant historical feature. Only one site at present is listed on the National Register of Historic Places, but a more systematic search would likely identify other potential nominees.

Soils

The subbasin includes two well-defined topographic subdivisions: the Drift Prairie Plateau in the west, and the Red River Valley in the east. The Pembina Escarpment divides these two regions.

The thin glacial till layer of soil in the Drift Prairie Plateau is composed of a heterogeneous mass of clays, sands, gravels, and boulders. In the river valleys and streams, the soils consist of alluvial deposits of clays, silts, and lenses of sand and gravel. Moderately well drained and somewhat poorly drained soils dominate the area. The central portion near the Pembina Escarpment contains predominantly silty sands and gravels. In the lake bed area, soils consist of upper alluvial sandy silts and lower lacustrine clays. Most of the soils are naturally fertile and much of the subbasin is considered prime farmland.

Water

Only two percent of the subbasin's total land area is occupied by water. The Homme Lake, created by the Homme Dam Project, is an important recreational area, and there are a few small lakes (Waterloo, Salt Lake) scattered throughout the subbasin. The Park River and its branches also provide water for a variety of purposes.

Woodlands

The remaining woodlands and bushy areas of the subbasin are significant because of their value as habitats for wildlife and because woodlands have been cleared to a great extent for other land uses, particularly agricultural development. The Soil Conservation Service (1964, 1965) reported that 1.3 percent, or 1,540 acres, of the Willow Creek-Park River Watershed is forested, and 8.0 percent, or 8,478 acres, of the Middle Branch-Park River Watershed

is in woodland. The Soil Conservation Service (1980) in a draft planning report indicated that 5.0 percent, or 8,470 acres, of the North Branch Park River Watershed is forested and stated that decreases in woodland acreages during the 1950's and 1960's were occurring at an average of 53 acres per year. Conversions to cropland and pasture are now occurring at a slower rate since most of the more level forests have been converted. Along the South Branch of the Park River, Kannowski (1971) reported that only eight percent of a 2-mile wide strip between Oakwood and a point 10 miles west of Grafton is forested, while 23-24 percent of the land is in woodland from Homme Dam to a location more than nine miles west of the reservoir. The higher woodland percentages occur in an area with rugged topography.

Kannowski (1971) indicated that a mature hardwood forest of approximately 140 acres is located in sections 7 and 18 of Grafton Township on the South Branch of the Park River west of Grafton. Increment borings and the large size of the trees in this floodplain forest show that this woodland is of pre-settlement origin; some trees are 155 years old. It is not being pastured and has apparently not been used for any purpose in the past. The only disturbance is a legal drain that diverts flows in the river. Kannowski reported that "although the woody species are not unique, this forest is unusual for its mature conditions, relatively large acreage involved, and relatively undisturbed condition." The present condition of this stand is unknown; channel modifications associated with the water supply dam east of Grafton on the Red River had the potential of disrupting this native forest.

The woodlands of the subbasin need to be protected, conserved, and enhanced where possible because they are the most important habitat type for wildlife. They are being cleared for other land uses, and at least one tract is of ecological value because of the reasons described in the previous paragraph.

Wetlands

The wetlands of the subbasin are important because of their many functional uses and values such as waterfowl production areas, habitats for flora and fauna, water storage capacity during spring runoff and

periods of extreme precipitation, groundwater recharge, and sediment and nutrient traps (Cernohous, 1979; U.S. Fish and Wildlife Service, 1979; E.O. 11990, dated 24 May 1977). Like the woodlands, they are also significant because their number and areal extent have been decreased in favor of agricultural development and other land uses.

Table 9 gives the number and areal extent of wetlands in the North Dakota counties included by the subbasin. The figures were obtained during a 1964 inventory based on a 25 percent sampling of the wetlands within these counties. The number and acreages of all Type 3, 4, and 5 wetlands were multiplied by four to expand the 25 percent sample to 100 percent. Type 1 wetlands were not measured in the 1964 survey. The number and acreages of Type 1 wetlands, however, were estimated based on previous studies, which indicated that they comprise about 60 percent of the total wetland numbers and 10-15 percent of the total wetland acres in the Prairie Pothole Region. Although no acreage figures are available for wetlands drained and converted to cropland, most have been drained in eastern North Dakota. Current annual wetland drainage estimates are thought to be less than two percent of the remaining wetland base, except in isolated areas where it may be higher (U.S. Fish and Wildlife Service, 1979).

As of 1964, a total of 32,611 wetlands accounting for 59,578 acres remained within the three counties encompassed by the subbasin's limits.

Grasslands

It was indicated earlier in the resource base or Existing Conditi section that remaining stands of prairie vegetation were confined to roadsides, railroad rights-of-way, fence lines, deforested river banks and slopes, abandoned farmland, county churchyards and cemetaries, and in some grassland pastures. Where practicable, these remnants should also be protected, conserved, and enhanced since very little of the native prairie remains in this highly agriculturalized region. Additionally, they furnish excellent habitats for wildlife, especially when occurring in association with wetland complexes.

Table 9

1964 WETLAND INVENTORY DATA FOR THE THREE COUNTIES INCLUDED BY THE PARK RIVER SUBBASIN

	WETLAND TYPES [a]									
	I		III		IV		V		TOTAL	
County	Number[b]	Acres[c]	Number	Acres	Number	Acres	Number	Acres	Number	Acres
Pembina	14	23	19	75	4	77	0	0	37	175
Walsh	2,120	1,759	3,500	10,982	30	700	4	45	5,654	13,486
Calalier	10,095	5,989	16,525	36,955	292	2,940	8	33	26,920	45,917
TOTAL	12,229	7,771	20,044	48,012	326	3,717	12	78	32,611	59,578

[a]Type 1 - Seasonally flooded basins and flats

Type 3 - Shallow fresh marshes

Type 4 - Deep fresh marshes

Type 5 - Open fresh water

[b]Calculated at 60 percent of total wetland numbers.

[c]Calculated at 15 percent of total wetland acres.

Source: U.S. Fish and Wildlife Service 1979.

Waterfowl Production Areas

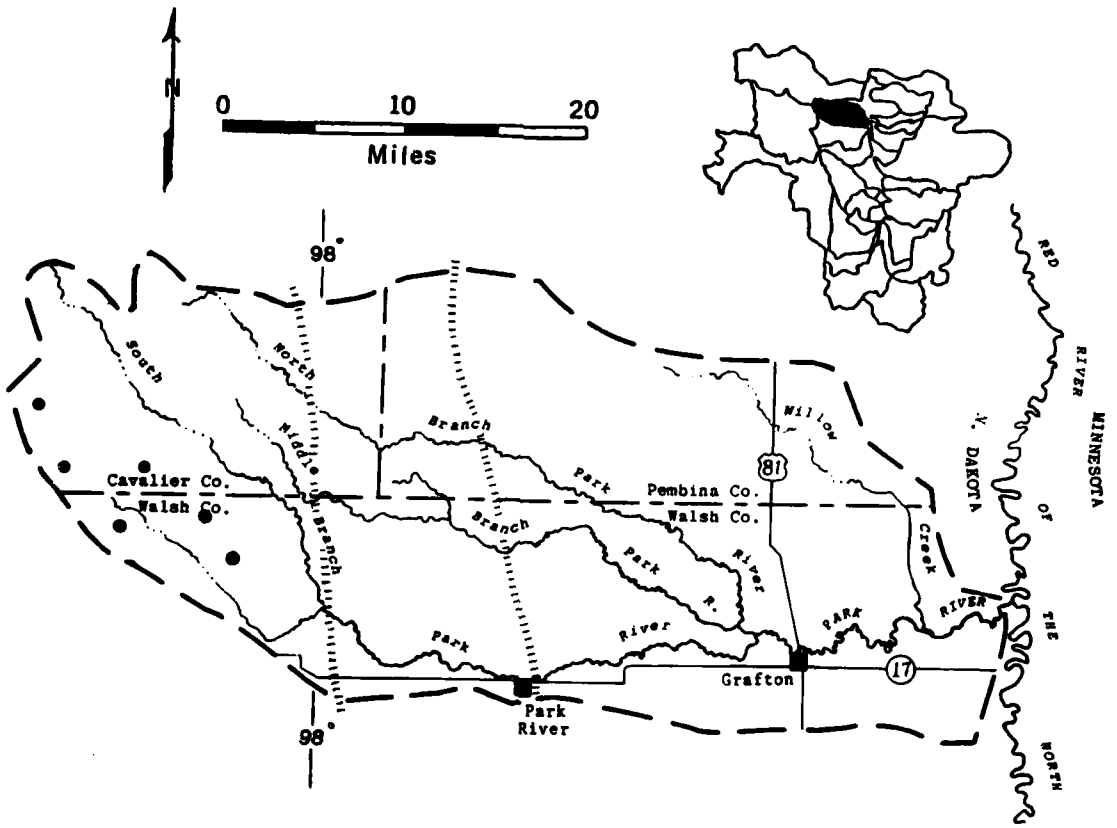
Waterfowl Production Areas (WPAs) are wetland areas that the Fish and Wildlife Service (FWS) has either acquired through fee title, or obtained an easement interest in, to preserve valuable breeding, nesting, and feeding habitat for migratory waterfowl. These wetland areas are purchased, or an easement interest obtained, with funds received from the sale of migratory bird hunting and conservation stamps (Duck Stamps). These WPAs are significant because they provide the public with a great variety of wildlife-oriented recreational opportunities, as well as providing valuable habitat for migratory waterfowl and many other forms of wildlife. FWS is responsible for the compatibility determinations (uses) and the issuance and denial of permits involving these lands. WPAs acquired in fee title are managed for optimum wildlife production, particularly waterfowl. On easement WPAs, the rights acquired are limited to the burning, draining and filling of wetland basins and the right of access. All other property rights remain with the landowners. The approximate locations of the WPAs acquired in fee within the subbasin are shown in Figure IV. Total acres of these WPAs fee and easement, within Cavalier, Pembina and Walsh counties, North Dakota, is given in Table 10.

Table 10

WATERFOWL PRODUCTION AREAS (WPAs) AND WETLAND EASEMENT AREAS OF THE COUNTIES INCLUDED IN THE PARK RIVER SUBBASIN

County	WPAs (Acres)	Wetland Easement Areas (Acres)	Total (Acres)
Cavalier	9,461	13,900	23,361
Pembina	2,142	139	2,281
Walsh	1,323	8,758	10,081
TOTAL	12,926	22,797	35,723

Source: U. S. Fish and Wildlife Service, Fee and Easement Interests in Real Property, 1979.



● WATERFOWL PRODUCTION AREAS (Fee Tracts)

*The exact locations and numbers of Waterfowl Production Areas are on file at the U.S. Fish and Wildlife Service, Area Office, Bismark. No copies of these maps have been published or released but can be reviewed at the above office.

Source: State Comprehensive Outdoor Recreation Plan, 1975.

Figure IV. WATERFOWL PRODUCTION AREAS

Wildlife Management Areas

Two wildlife management areas are situated within the subbasin. A list of these areas and their acreages and locations were presented in the Existing Conditions section for recreation. These areas are significant because of the opportunities provided for outdoor recreation and the protection and management given to biological resources within their confines.

Threatened or Endangered Species

The bald eagle and American peregrine falcon are endangered birds that include the Park River Subbasin in their wintering range. Neither currently breeds in the area. Both have received adverse effects from pesticide pollution (especially DDT and its derivatives) and other pressures brought on by civilization. Another threatened animal which has been reported from the subbasin is the pearl dace. This small minnow inhabits cool, clear pools and requires a sand or gravel bottom for spawning purposes. The pearl dace is especially fond of areas that have permanent springs. The pearl dace populations have declined in recent years due to the loss or disturbance of their preferred habitat through channelization, impoundment, and siltation (McKenna and Seabloom, 1979).

Other Important Species

Five animal species found in the subbasin are considered important or of special interest because they are peripheral species, which means that these animals are living along the extreme edges of their ranges. Two fishes, the central mudminnow and blackchin shiner, inhabit the Red River and most of its major tributaries. The gray tree frog is a peripheral eastern species that is reaching its western limits. The pileated woodpecker is another peripheral species. It, too, is an eastern species in the western extremes of its range. The pileated woodpecker prefers extensive stands of deciduous or mixed forests along streams. The northern waterthrush is a peripheral avian specie known to exist locally in Walsh County.

Rare and Unique Plants

The only plant found in the Park River Subbasin that is considered rare or unique by Barker et al. (1976) in North Dakota is the wineleaf cinquefoil. The wineleaf cinquefoil is a rare plant that grows on exposed areas of Pierre shale.

Natural Areas

Natural areas are lands that are preserved because they contain a unique or rare biotic community or geologic or archeologic features that would provide a scientific or esthetic value. No natural area has been established within the subbasin.

V. FUTURE CONDITIONS

V. FUTURE CONDITIONS

The subbasin's future economic, social, and environmental conditions and resources are discussed below in terms of "most probable" and "without project" conditions.

Most Probable Economic Conditions

The communities of the subbasin, particularly Grafton and Park River in Walsh County, will continue to serve the needs of the surrounding agriculture-based rural areas. Redevelopment efforts for the western and central parts of this county that were affected in the late 1970's by deactivation of ABM complexes will continue. Population, which increased by 2.3 percent between 1970 and 1977, will continue to grow (although at a slightly reduced rate) as will employment and per capita income, which is shown in Table 11.

Table 11

PARK RIVER SUBBASIN, POPULATION, EMPLOYMENT, AND PER CAPITA INCOME PROJECTIONS, 1970-2030

Parameter	1970	1977	1980	1990	2000	2010	2020	2030
Population	13,867	14,192	14,500	14,800	15,100	15,400	15,700	16,000
Employment	4,853	6,954	6,900	7,100	7,300	7,500	7,600	7,800
Per Capita Income (Dollars)	5,187	5,957	7,500	9,750	12,700	16,500	21,400	27,800

Sources: U. S. Water Resources Council, 1972 OBERS Projections, Series E; and Gulf South Research Institute.

Population and employment projections were developed by GSRI based on recent trends and state and regional estimates. OBERS E figures appear to underestimate growth trends for the non-SMSA portions of the Grand Forks area, since agricultural employment has stabilized and a slow reversal in population and employment decreases has been witnessed. OBERS E and E' projections were, however, designated as most probable for per capita income and agricultural activity estimates.

A predominantly agricultural-based economy is forecasted to continue, with a negligible likelihood of economic diversification within this subbasin, unless spin-offs take place from the Grand Forks area or through redevelopment efforts. Recurring flooding problems that affect some 95,000 acres and the towns of Grafton and Park River are viewed by local leaders and planners as the biggest hindrances to economic growth and development.

Most Probable Agricultural Conditions

Roughly 504,200 acres within the subbasin are currently under cultivation, and wheat, barley, and sunflowers are the principal crops produced. The total production of these three crops alone is estimated to be worth $36.6 million in 1980 (using October 1979 Current Normalized Prices for North Dakota). This total value of production figure is projected to increase to $61.5 million by the year 2030 (using October 1979 Current Normalized Prices for North Dakota). Projected production of these three principal crops is presented in Table 12.

Table 12

PARK RIVER SUBBASIN, PRINCIPAL CROPS AND PROJECTED PRODUCTION, 1980-2030
(Production in Thousands)

Year	Wheat (Bushels)	Barley (Bushels)	Sunflowers (Pounds)
1980	7,106	5,257	59,513
1990	8,242	6,098	69,035
2000	9,379	6,940	78,558
2010	10,090	7,465	84,509
2020	10,800	7,991	90,460
2030	11,937	8,832	99,982

Sources: OBERS Series E'; and Gulf South Research Institute.

Evaluation of Flood Damages--Future Conditions

A summary of present and future average annual flood damages is presented in Table 13. Using a discount rate of 7 1/8 percent, equivalent average annual damages are $3.0 million. Urban damages at Grafton account for 65 percent of this figure, and rural damages account for the remaining 35 percent.

Flood damages to residences, businesses, industrial structures, churches, schools, automobiles, house trailers, public property and contents are included in the urban damages category. Damages to streets and utilities (including water, gas, electricity, sanitary sewers, storm sewers, and telephone systems) are also taken into consideration. This category also includes loss of wages, loss of profits, expenditures for temporary housing, cleanup costs, and extra expenses for additional fire and police protection and flood relief.

Agricultural flood damages consist of crop and pasture damage, which may include costs of replanting, refertilizing, additional spraying, reduced crop yields, loss of animal pasture days, and other related flood losses.

Other agricultural damages consist of land damage from scour and gully erosion and deposition of flood debris; livestock and poultry losses; damages to machinery and equipment, fences, and farm buildings and contents (excluding residences); and damages to irrigation and drainage facilities.

Transportation damages include all damages to railroads, highways, roads, airports, bridges, culverts, and waterways not included in urban damages. In addition, all added operational costs for railroads and airlines and vehicle detours are included.

Future growth of urban flood damages was estimated to be an uncompounded (straight-line) rate of one percent per year for a 50-year period beginning in the base year, with no growth thereafter.

Agricultural crop flood damages were projected to increase at the same rate as crop income projections published in the 1972 OBERS Series E projection report. These crop income projections were prepared by the U.S. Economic Research Service (ERS) for the Red River of the North region. Other agricultural flood damages were projected to increase at one-half of this rate.

Table 13

PARK RIVER SUBBASIN, SUMMARY OF PRESENT AND FUTURE AVERAGE ANNUAL DAMAGES URBAN, AGRICULTURAL, AND TRANSPORTATION (October, 1979 Prices, 7 1/8 Percent Interest)

Category	Flood Damages						Increase 1980-2030	Average Annual Equivalent Factor	Average Annual Equivalent of Increase	Equivalent Average Annual Damages
	1980	1990	2000	2010	2020	2030				
Urban										
Grafton	1,692,300	1,861,500	2,030,800	2,200,000	2,369,200	2,538,500	846,200	0.2903	245,600	1,937,900
Agricultural										
Crop	650,200	754,200	858,300	923,300	988,300	1,092,300	442,100	0.2903	128,400	778,600
Other Agricultural	216,800	234,100	251,500	262,300	273,200	290,500	73,700	0.2903	21,400	238,200
Transportation	32,500	32,500	32,500	32,500	32,500	32,500	--	--	--	32,500
TOTAL	2,591,800	2,882,300	3,173,310	3,418,100	3,663,200	3,953,800	1,362,000	0.2903	395,400	2,987,200

Source: Gulf South Research Institute.

Transportation damages are not expected to change throughout the project life because of the long-term economic life associated with such structures as bridges, railways, roads, and culverts. In addition, it has been found that repairs to these types of structures rarely exceed the cost of a new structure, even with frequent flooding.

Most Probable Environmental Conditions

Improvements in water quality will occur with successful implementation of point and nonpoint source pollution abatement programs. The nonpoint source program will take substantially longer to implement. These improvements will benefit aquatic biota, as well as wildlife that utilize aquatic habitats. However, periodic problems with low stream flow are expected to continue to restrict the fisheries of the subbasin.

Both native woodlands and wetlands are expected to decline through conversion of these lands for agricultural development and other uses. Woodland losses may be offset, however, with shelterbelt, windbreak, and greenbelt plantings with such programs as 208 planning. Decreases in these habitats will result in diminishing plant and animal populations that depend wholly or in part upon these environs.

Without Project Conditions

It is likely that the scenario set forth as the most probable future of the subbasin will prevail during the 50-year planning period in the absence of a plan to alter resource management programs.

VI. EXISTING FLOODPLAIN MANAGEMENT PROGRAMS

VI. EXISTING FLOODPLAIN MANAGEMENT PROGRAMS

Institutions

The development of effective water resources management practices in the subbasin is affected by a large number of Federal, state, and local agencies involved in project planning and implementation. There are 44 Federal agencies with various types of jurisdictions, and 14 directly involved in the water and related land resource planning process. At the state level, seven agencies are involved. There are also regional commissions, county agencies, and municipal entities. Differences in perspective and problems of coordination hamper the effective and speedy resolution of problems.

The primary local agencies involved in water resources management in the subbasin are the water management districts for Pembina, Cavalier, and Walsh counties. The districts have jurisdiction in a broad range of water resources management programs, including flood control, water supply, and water conservation. The water management districts in the subbasin, however, have not developed overall plans for the area, and there is no single plan that approaches the subbasin as a hydrologic unit.

The major Federal agencies with water resource development interests in the area are the Soil Conservation Service (SCS) and the St. Paul District Corps of Engineers. The Pembina, Cavalier, and Walsh county soil conservation districts are also involved in water resources and related land management programs in the subbasin. The Corps of Engineers completed Homme Dam, a multi-purpose project, in 1951 and a snagging and clearing project for Park River in 1960. The Soil Conservation Service has completed a project for the Willow Creek-Park River Watershed and is currently constructing retarding structures in the Middle Branch, Park River Watershed.

The Corps of Engineers, the SCS, the North Dakota State Water Commission, the three water management districts and soil conservation districts, and the town of Grafton should be taken into consideration in flood control planning for the subbasin. In devising an effective flood control program,

perceptions of the effects of upland drainage patterns on flooding problems in the valley are important to the successful resolution of these problems. Therefore, the town of Park River should also be consulted. It should be noted that the Red River and North Central Planning Councils have developed comprehensive land use plans that include the subbasin area.

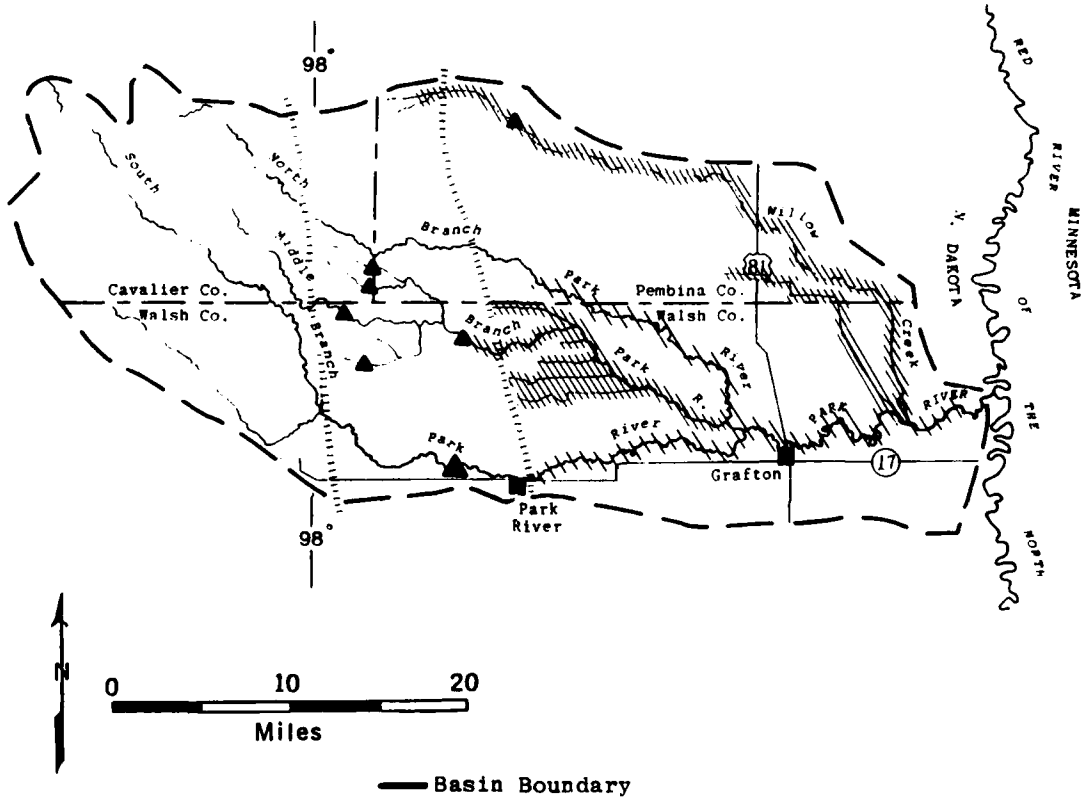
Structural Measures

Under the authority of Public Law-566, the Soil Conservation Service (SCS) in cooperation with local interests has completed extensive flood control and water resource management measures in the subbasin. The Corps of Engineers has completed several flood control projects, including a multi-purpose reservoir and channel clearing and snagging projects. Private interests have constructed about 30 miles of drainage and channel improvements in the subbasin. The locations of existing floodwater control and agricultural water management measures are shown in Figure V and include the following:

1. The Willow Creek-Park River Watershed project was completed in 1978 by the SCS in cooperation with local interests under the authority of PL-566. The watershed covers 185 square miles in Cavalier, Pembina, and Walsh Counties in North Dakota. Flood prevention improvements included both structural and land treatment measures. Structural measures included one floodwater retarding structure, with 2,178 acre-feet for flood storage, and 56.1 miles of channel improvements. The North Salt Lake Wildlife Management Area was developed as part of this project.

2. The Middle Branch-Park River Watershed covers 165 square miles in Walsh, Pembina, and Cavalier Counties in North Dakota. This project includes both structural and land treatment measures for flood control. Structural measures include five floodwater retarding structures, with a total flood storage capacity of 11,759 acre-feet, and 37.6 miles of floodway and channel improvements. This project is being constructed by the SCS in cooperation with local interests under the authority of PL-566. Four of the reservoirs are complete and in service. This project is scheduled for completion in FY-81.

3. Homme Dam and Lake on the South Branch Park River near the community of Park River was constructed by the Corps of Engineers. This multi-purpose reservoir, constructed for water supply and flood protection, has 3,380 acre-feet of multi-purpose storage. This reservoir provides



Source: Gulf South Research Institute.

Figure V. EXISTING FLOOD CONTROL MEASURES

low-flow augmentation for water supply and water quality control and, through a winter drawdown program, limited storage for regulation of spring flows.

4. Between 1950 and 1960, the Corps of Engineers completed channel clearing and snagging from river miles 10 to 60 on the South Branch, on the Middle Branch from its confluence with the South Branch to river mile 60, and the lower 33 miles on the North Branch. Some of these channels were further improved in the SCS channel improvement projects.

5. Prior to 1947, about 30 miles of drainage improvements were completed by local interests, including a three mile channel cutoff on the South Branch about six river miles upstream from Grafton.

Nonstructural Measures

Nonstructural flood control measures are measures that reduce or eliminate flood damages through procedures that involve little if any construction efforts. The major types are flood warning, floodplain zoning, flood insurance, flood proofing and floodplain evacuation. These measures are primarily applicable to urban areas.

The towns in the subbasin participate in the Red River Valley flood warning system. The flood warning system for the Red River Valley is a cooperative network organized by the National Weather Service in Fargo, North Dakota. Fifty volunteers throughout the basin report to the National Weather Service on a weekly basis during winter and fall and on a daily basis during spring and summer. The reportage covers all precipitation of 0.1 inch or more, including amounts of snow and water equivalent. This information is transmitted to the River Forecast Center in Minneapolis, where it is run through a computer system to determine probable flood stages. The predictions are then transmitted to the National Weather Service in Fargo, which releases them to the public through the news media. Communities are then able to engage in emergency actions to protect themselves from flood damages. Contacts with local officials indicate that the flood warning system generally works quite well in the subbasin.

The Final Environmental Impact Statement for Flood Control at Grafton, North Dakota, Park River, August, 1975 reports that no type of floodplain regulations had been adopted for this subbasin.

There are other types of measures that could be implemented in the subbasin to reduce flood damages but that are not directly applicable to urban areas. These measures would include such things as land treatment programs, use of present drainage ditches for floodwater storage, and use of natural areas for water retention. Land treatment is used by some farmers in the subbasin, but the Soil Conservation Service has not been called upon to undertake a large-scale program. Present drainage ditches are not used for floodwater storage because they are filled to capacity during flood stages. Information on natural storage areas and potentialities for increased storage is not available.

Adequacy of Existing Measures

Floodwater retarding structures in the Willow Creek-Park River Watershed provide this watershed with four percent (25-year) flood protection, and channel improvements provide 6-8 percent protection. Total average annual damages have been reduced by 72 percent. Structural improvements in the Middle Branch-Park River Watershed reduce average snowmelt runoff by 83 percent and the average reduction of flooding from summer storms by 94 percent. Average annual damages are estimated to be reduced by 91 percent.

The improved lower Park River channel has a capacity of about 1,200 cfs. Ths SCS structural improvements in combination with Homme Dam and Lake and other Corps of Engineers and private channel improvement projects have reduced the one percent (100-year) flood discharge at the Red River of the North for this subbasin from about 33,000 cfs to about 22,000 cfs, based on 1972 stream flow data, which is a reduction of 33 percent. The improved channel capacity of the lower Park is about 1,200 cfs. This analysis indicates that present structural improvements provide this subbasin with about 24 percent (4.2-year) flood protection.

The SCS has investigated 31 possible reservoir sites in this subbasin in addition to those where reservoirs were built. These investigations revealed that none of the 31 sites were suitable for a reservoir.

Presently, urban damages at Grafton, North Dakota, account for a significant portion of the total flood damages in this subbasin. Further flood prevention measures addressed in this subbasin should be directed toward the City of Grafton.

VII. CRITERIA AND PLANNING OBJECTIVES

VII. CRITERIA AND PLANNING OBJECTIVES

Floodplain Management Criteria

Technical, economic, and environmental criteria must be considered when formulating and evaluating alternative floodplain management measures for the subbasin.

The technical criteria used in formulating and evaluating alternatives for this report consisted of the application of appropriate engineering standards, regulations, and guidelines.

Economic criteria entailed the identification and comparison of benefits and costs of each measure. Tangible economic benefits must exceed costs; however, in certain instances, considerations of appropriate gains in the other accounts (environmental quality, social well-being and regional development) could alter this requirement. All alternatives considered are scaled to a design which optimizes benefits. Annual costs and benefits are based on an interest rate of 7 1/8 percent and price levels and conditions existing in October 1979. A 50-year amortization schedule is used for the features considered.

Environmental considerations call for the formulation of measures that minimize objectionable or adverse environmental effects and maximize environmental benefits. Also, limited consideration was given to modifications based on coordination with state and Federal agencies, local interests, and citizen groups.

Planning Objectives

The primary planning objective of this study was to contribute to flood reduction needs in the subbasin and thereby provide protection from or reduction of flood losses. In conjunction with this economic objective, the study attempted to develop contributions to the environmental quality of the subbasin.

The development of planning objectives involved a broad-range analysis of the needs, opportunities, concerns, and constraints of the subbasin from the information that was available. On the basis of the identified problems, needs, and desires that could be identified, the following planning objective were established:

1. Contribute to protection from and prevention, reduction, or compensation of flood losses for the flood prone areas of the subbasin during the period of analysis.

2. Contribute, to the maximum extent possible, to the preservation of the quality of the existing riverine environment and enhance the environmental potential of the subbasin as a whole.

3. Contribute to the enhancement of recreational opportunities throughout the subbasin.

4. Contribute to the improvement of water quality in Park River.

5. Contribute to the improvement of water supply, especially in the city of Grafton.

6. Contribute to the reduction of wind and water erosion throughout the subbasin.

7. Contribute to the development of irrigation throughout the subbasin.

8. Contribute to the reduction of wastewater management problems, particularly insofar as they relate to water quality.

9. Contribute to the development of small hydroelectric installations in the subbasin.

VIII. FORMULATION OF ALTERNATIVE MEASURES

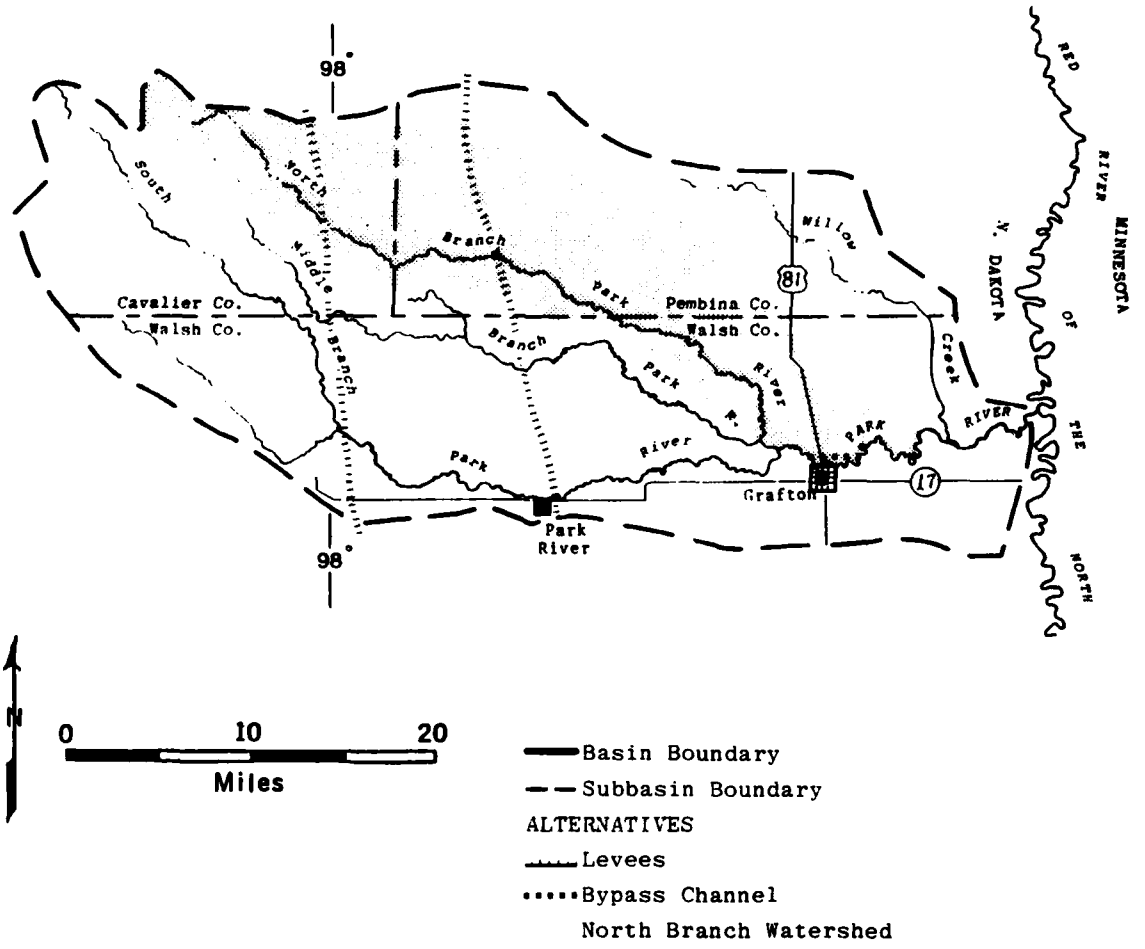
VIII. FORMULATION OF ALTERNATIVE MEASURES

Management measures that have been identified to satisfy the resource management objectives are discussed in this section. In the formulation of measures, prime consideration was given to the resolution of flooding problems. Measures to satisfy the other planning objectives were considered exclusively as components of the flood control measures. The following measures, which are shown in Figure VI, were devised in response to the flood control planning objective:

1. A combination of levee and flood bypass channel at Grafton. This plan would provide adequate flood protection for the City of Grafton but would not reduce flood damages in the rest of the subbasin. Average annual flood damages in the subbasin would be reduced by about 76 percent, and about 90 percent of Grafton's residents living in flood prone areas would be protected. The Corps of Engineers Interim Survey Report for Flood Control And Related Purposes, Park River Subbasin, North Dakota, September 1973, considered six structural measures for flood control in the subbasin. This measure is the recommended plan and has been authorized for construction by Congress, which appropriated funds to begin the Phase 1 General Design Memorandum in FY-1980. However, there has been opposition to the project at the local level. Citizens expressed concern that the cost to them for construction operation, and maintenance on the proposed project would create a perpetual burden on the city taxpayers. Therefore, in Phase 1 the Corps will reformulate alternative plans to determine if the authorized plan or an alternate plan better reflects public desires.

2. Construction of levees around individual farmsteads in the one percent (100-year) floodplain. These levees would protect individual farmsteads against the one percent flood and could be constructed by the Corps of Engineers, the SCS, or private interests.

3. North Branch-Park River Watershed. Planning for land treatment and structural measures for flood damage reduction in this 267 square mile watershed has been approved. The primary purpose of this project would be to accomplish a water management program what will afford reasonable protection from flood damage and provide a system of outlet channels for farm drainage. This project would do much to control erosion, reduce runoff, and eliminate much damage to farmland, roads, and bridges. A planning study is in progress; however, structural details have not yet been determined. (Note: A recently released planning report on this project indicates that it is infeasible. Planning has been terminated.)



Source: Gulf South Research Institute.

Figure VI. ALTERNATIVE FLOOD CONTROL MEASURES

Engineering Methodology

Information used in this analysis was developed from prior studies and reports and existing streamflow data. Discharge-frequency curves for the Park River at Grafton and at its confluence with the Red River were derived for the conditions "with" and "without" structural improvements to determine the effect of existing structural measures on stream discharges for various frequencies. The capacity of the channel near the river's mouth was estimated using an actual stream cross section and data obtained from prior studies. All of this derived data was used to estimate the subbasin's present level of flood protection.

The farmstead levee alternative is based on data obtained from studies by the Corps of Engineers. Estimated capital costs are based on the assumption that individual owners would construct their own levees. Capital costs for alternative measures one and two were developed by updating capital costs from prior studies to October, 1979 price levels or by using October, 1979 unit construction costs. The capital cost and average annual benefits for alternative measure three were derived from composite costs and benefits per acre of watershed improvement projects in the Red River basin. These costs and benefits also reflect October, 1979 price levels.

This analysis of the effect of flood damage reduction measures has been based on available streamflow and hydrological data, which is limited for this subbasin. Estimates of the effects of existing structural measures have been based on this available data.

Nonstructural Measures

Among the nonstructural measures considered in previous reports were flood warning and forecasting services, emergency protection measures, permanent floodplain evacuation and flood proofing. These measures are discussed in the following paragraphs.

Floodplain regulation and flood insurance are currently required by Federal policies and encouraged by the State of North Dakota. This measure primarily consists of regulating new development in existing floodplain areas and the insuring of affected property owners for losses

from flood damages. The entire community of Grafton is located in the floodplain, and the nearest high ground is located over 15 miles away. Floodplain regulations do not currently exist in the subbasin, and Federally subsidized insurance has not been applied for and is not currently available in the subbasin. Floodplain regulation should be a part of any flood protection system and could be effective in Park River and rural areas. As a supplement to floodplain regulation, flood insurance could provide limited protection to existing developments. In the long-run, floodplain regulation would theoretically eliminate all nonconforming floodplain structures, thereby reducing flood damages.

Unsubsidized crop insurance is available through the U. S. Department of Agriculture Federal Crop Insurance program, which covers all natural disasters including floods. However, actual crop damages could be reduced only to the extent that intensive farming practices would be discouraged in the long-run in the floodplain. Because of the highly productive nature of floodplain farming, it is very doubtful that any long-term shifts away from the intensive farming of floodplain areas would occur.

Flood warning and forecasting services in conjunction with emergency protection measures have been used with reasonable success. Evacuation is possible due to the prolonged nature of the rise of flood waters from major flood events;, but particularly in the case of summer floods, time would not permit the erection of emergency flood protection works. Due to the broad extent of the floodplain, the large number of persons involved, and the unavailability of facilities in neighboring communities to accommodate affected persons, this alternative is not seen as economically or socially acceptable as an effective means of solving flooding problems in the subbasin. However, it is recommended that flood warning and forecasting services be continued in order to alert floodplain residents of impending dangers.

Permanent evacuation of flood prone areas would consist of the acquisition of lands, relocation of improvements and resettlement of the population, ultimately resulting in the conversion of land use to a state less susceptible to flood damages. Impacts of this alternative would primarily be cultural and economic in nature. Flood proofing would involve structural changes

and adjustments to properties in an effort to reduce or eliminate flood damages. This is most effective when applied to new construction, but can be applied to existing structures in some instances. Permanent evacuation would result in the disruption of long-established social and cultural relationships, but could eliminate flood damages to structural units, providing that floodplain regulations were enforced. Furthermore, health and safety of floodplain residents would be enhanced and natural habitats would be improved. However, the residual damages to agriculture, and the economic, social and cultural impacts of these two measures would more than offset the benefits.

The preceeding discussion summarizes the results of prior Corps of Engineers investigations. In addition to the nonstructural measures mentioned in the Corps reports, there is an opportunity for the use of land treatment measures throughout the subbasin that would help to contain water on land as well as reducing runoff related erosion damages. Other measures would include, but not be limited to, water retention in existing ditches and preservation of natural retention areas. These would need to be identified and retention capacities would need to be determined. Wetland restoration could also be considered, where appropriate, for water retention.

IX. ASSESSMENT OF ALTERNATIVES

IX. ASSESSMENT OF ALTERNATIVES

Economic Assessment

The majority of the Park River Subbasin lies below the escarpment area and is characterized by extremely flat terrain with sluggish drainage. Flood waters frequently overrun the broad natural levees that border the branches and main stem of the Park River inundating broad areas of adjacent cropland. In addition, overland flow not associated with the river flow moves slowly eastward from the escarpment in the area just south of the South Branch of the Park River, inundating section after section of farmland.

The effects of the flood control alternatives for the subbasin and their costs and benefits are presented in Table 14.

Information used in this analysis was extrapolated from prior studies and reports and existing stream flow data. Discharge frequency curves for the Park River at Grafton and at its confluence with the Red River of the North were derived for the conditions "with" and "without" structural improvements to determine the effect of existing structural measures on stream discharges for various frequencies. The capacity of the channel near the river's mouth was estimated using an actual stream cross-section and data obtained from prior studies. All of the aforementioned data was used to estimate the subbasin's present level of flood protection.

Alternative one consists of a combination urban levee and flood bypass channel at Grafton. This measure is the recommended plan of the Interim Survey Report for Flood Control and Related Purposes, Park River Subbasin, North Dakota completed by the Corps of Engineers in September 1973. Capital costs used in the economic analysis included interest during construction. This measure has been authorized for construction by Congress, which appropriated funds to begin the Phase I General Design Memorandum in Fiscal Year (FY) 1980. The project will provide protection for Grafton against the one percent (100-year) frequency flood. Economic evaluation of this alternative yielded a benefit/cost ratio of 1.27.

Table 14

ECONOMIC EVALUATION OF ALTERNATIVES

Alternatives	Acres Protected	Average Annual Acres	Capital Costs	Average Annual Costs	Average Annual Rural Benefits	Average Annual Urban Benefits	Total Average Annual Benefits	B/C Ratio
1. Combination Levee and Flood Bypass Channel at Grafton (1 percent Flood)	--	--	$16,447,000	$1,210,600	--	$1,537,800	$1,537,800	1.27
2. Farmstead Levees (Per Levee)	--	--	5,600	400	840	--	840	2.10
3. Water Management Plan, North Branch-Park River (Land treatment and structural measures)	--	--	4,454,000	327,900	326,000	--	326,000	0.99

Source: Gulf South Research Institute.

Alternative two consists of the construction of levees around individual farmsteads in the one percent (100-year) frequency floodplain. These levees would protect individual farmsteads against the one percent frequency flood and could be constructed by private interests. Economic evaluation of this alternative yielded a benefit/cost ratio of 2.10.

Alternative three consists of land treatment and structural measures for flood damage reduction. The primary objective of this project would be to provide a water management program which would afford reasonable protection from flood damage and provide a system of outlet channels for farm drainage. Economic analysis of this alternative yielded a benefit/cost ratio of 0.99.

Impact Assessment

Table 15 provides a generalized statement of anticipated impacts on various key resource elements resulting from each of the three structural measures being considered. The rationale used in developing the ratings is presented below.

Table 15

ASSESSMENT OF MEASURES, BY RESOURCE ELEMENT,
PARK RIVER SUBBASIN

Measures	Social	Economics	Land Use	Biology	Water Quality	Water Supply	Cultural	Recreation
Combination Levee and Flood Bypass Channel at Grafton (1 percent Flood)	MaB	MaB	MiB	MiA	MiA	NKE	NKE	MiA
Farmstead Levee	MiB	MiB	NKE	NKE	NKE	NKE	NKE	NKE
Land Treatment and Structural Measures North Branch, Park River	MoB	MoB	MiA	MiA	MiA/MiB	NKE	NKE	NKE

Note: NKE = No Known Effect
MiA = Minimally Adverse
MoA = Moderately Adverse
MaA = Maximally Adverse
MiB = Minimally Beneficial
MoB = Moderately Beneficial
MaB = Maximally Beneficial

Source: Gulf South Research Institute.

Combination Levee and Flood Bypass Channel at Grafton

The Office of the Chief of Engineers' document entitled Final Environmental Impact Statement, Flood Control at Grafton, North Dakota provides the basis for discussion of anticipated impacts resulting from a combination of levee and flood bypass channel at Grafton. This alternative would result in maximally beneficial social and economic effects; minimally beneficial land use effects; minimally adverse biological, water quality and recreation effects; and no known effects on cultural resources and water supply.

Social and economic benefits would accrue from providing protection for Grafton and vicinity. Despite the fact that the plan would protect some 6,000 persons, 1,700 residences and 330 businesses from the standard project flood, the entire basin would not be so protected, and a number of area citizens are concerned about community disruptions stemming from the levee and possible backwater effects outside the levee.

The provision of flood protection to the community and environs might tend to concentrate future development within the 2,700-acre leveed area as opposed to development in unprotected areas. Furthermore, 225 of the 235 acres of largely agricultural land that would be needed for flood control would be planted to native vegetation.

It was judged that minimally adverse biological and water quality effects would take place, mostly due to changes in the vegetation along that reach of the Park River and the reduced long-term productivity of the vegetation. The elimination of floodwater recharge might also tend to dry any productive, marsh-like, abandoned oxbows in the project area. Sediment loads would be altered during construction. The clearing of about five acres of floodplain forest would have a minimally adverse effect on the recreation potential as well as the aesthetic values of these areas.

Farmstead Levees

Minimally beneficial economic and social effects would result from the protection of numerous farmsteads in the 100-year floodplain. The other resource elements, excepting aesthetics and possibly public health, would have no known effects.

Land Treatment and Structural Measures, North Branch Park River

These measures, within a 267 square mile watershed, would provide an as yet undetermined amount of flood protection and a drainage system of outlet channels for farms. Tentative effects of seven structural alternatives have been presented in the March 1980 planning report for the watershed, and it can be judged that economic and social benefits are moderately beneficial (average annual flood damage reduction ranging from $18,000 to $350,000); land use impacts will be minimally detrimental, largely due to woodlands and prime farmlands losses; minimally adverse effects would take place on biological elements (loss in wildlife habitat and vegetation alterations) and water quality (due to construction activities). It is, however, anticipated that there will be a reduction in sediment and its associated pollutants over the life of several of these measures. No known effects would take place on water supply, cultural, and recreational elements.

X. EVALUATION

X. EVALUATION

Two alternative measures presented for the subbasin have benefit/cost ratios that exceed unity. They are the improvements at Grafton and the farmstead levees.

The combination levee and flood bypass channel would have favorable social well-being effects, and benefits stemming from largely urban and to a lesser extent rural protection would exceed costs. This alternative measure appears to maximize net economic benefits for the subbasin despite offering mostly urban benefits. The land treatment and structural measures recommended for further investigation in regards to the North Branch of the Park River have benefit/cost ratios of slightly under one.

The farmstead ring levees also exceed the above unity criteria but do not notably benefit the resolution of subbasin flooding problems. Greatest environmental enhancement would result from the land treatment programs associated with the above mentioned measures for the North Branch.

National Economic Development (NED) and Environmental Quality (EQ) plans will be tentatively formulated in association with the Red River of the North Basin's main reconnaissance report.

XI. ADDITIONAL STUDY NEEDS

XI. ADDITIONAL STUDY NEEDS

This report was developed almost entirely on the basis of secondary information from readily available planning documents. Data available from state and Federal agencies was not fully canvassed, and only a limited number of calls were made to the area. In particular, state university libraries and department resources could not be fully utilized. Thus, the document aims only at a broad-brush perspective. In order to provide a more detailed and in-depth analysis of subbasin resources, problems, and potential solutions, the following additional study needs would have to be fulfilled:

1. A literature search should be conducted to obtain available biological data for the subbasin. Fieldwork should be planned to fill in any data gaps which exist with the end result of obtaining good baseline data for the subbasin. This includes those areas where new flood control measures have been proposed, as well as updating any data for those projects which have been previously studied.
2. Areas of high environmental quality (e.g., prairie remnants and riparian woodlands) should be identified and inventoried within the subbasin.
3. Updated knowledge of the location, areal extent, and types of wetlands occurring within the specific subbasin boundaries would be extremely useful in determining whether wetland restoration would assist in alleviating flooding problems, as has been indicated by Cernohous (1979), and would provide a comparison for documenting wetland losses since the 1964 inventory.
4. Primary water and sediment quality data need to be obtained or updated to characterize baseline conditions in the streams of the subasin, particularly in those areas where flood control measures have been proposed.
5. Information pertaining to wastewater management needs to be updated.
6. The information obtained in items 1-5 above would provide an important data base upon which an impact evaluation of proposed flood control measures can be performed and would provide information relative to the cumulative effects of flood control projects on environmental resources in the subbasin. These projects include those that are in-place or proposed.
7. Nonstructural flood damage reduction measures should be thoroughly explored such as those listed below.

- Establishment of buffer areas and curtailment of inappropriate residential, commercial, and other development in floodplains.
- Maintenance and enchancement of existing riparian vegetation along the Park River and tributaries to conserve and restore wildlife habitats, help control wind and streambank erosion, retain soil on the land, and to reduce the amount of sediment, nutrients, and other pollutants entering waterways.
- Maintenance of grassed waterways to reduce erosion.
- Establishment of vegetation in areas of critical erosion.
- Determination of the feasibility of installing water control structures at existing culverts to retain water in drainage ditches for longer periods of time during critical runoff periods to minimize flooding in downstream areas.
- Determination of the feasibility of utilizing "on-farm storage" to control runoff through such means as natural storage areas and control structures on existing culverts.
- Prevention of overgrazing on grasslands and utilization of sound agricultural land use practices.
- Provision for strict enforcement of floodplain management programs within the subbasin.

8. The potentiality for land treatment measures (e.g. erosion control measures such as cover crops, green belts, reduction in fall tillage, etc.) needs to be thoroughly investigated.
9. The people of the subbasin need to be included in further water resource planning efforts. A public involvement program would provide more complete information on water resource problems and opportunities than is presently available.
10. More study is needed to determine the precise nature of the water supply problems and potential solutions.
11. Potentialities for floodwater storage in present drainage ditches need to be investigated.
12. The effect of drainage works on flood discharges and stages is unknown at present. It would take additional, more detailed studies to determine the extent and effect of reduced natural storage.
13. Land use within the floodplain needs to be precisely identified.
14. An adequate 100-year floodplain map needs to be developed. Also, the extent of floodplains for smaller frequency storms needs to be delineated.

15. More gauging stations need to be developed to provide hydrologic data for establishing flood frequencies and rating curves.

16. Channel cross-sections of the various streams need to be prepared for flood control planning purposes.

17. Crop distribution in the floodplain needs to be precisely identified through contact with county agents, and average annual rural damages need to be updated.

18. The irrigation potentials of the subbasin soils need to be investigated.

19. A comprehensive and up-dated inventory of recreation sites would be required to accurately identify resources.

20. Studies are needed to determine additional demand for recreational facilities, usage of existing facilities, and potential sites.

21. A regional supply and demand analysis for hunting, fishing, and other water based or related recreational pursuits is needed.

22. Whether forested acreages in the floodplain are increasing or declining needs to be precisely determined.

23. A detailed study of the objectives, goals, and programs of the many institutional entities involved in water resources planning, particularly at the local level, is needed to determine the most efficient institutional approach to the resolution of flooding problems.

24. A detailed institutional analysis of the subbasin is needed.

25. A detailed social profile of the subbasin is needed.

26. Urban damages need to be recomputed in a systematic fashion.

27. A review of secondary sources and systematic field reconnaissance is needed to identify archaeological and historical sites and to determine their eligibility for nomination to the National Register of Historic Places.

BIBLIOGRAPHY

BIBLIOGRAPHY

Barker, William T., Gary Larson, and Richard Williams. 1976. "Rare and Unique Plants of North Dakota". North Dakota State University. Fargo, ND.

Bureau of the Census. 1977. Census of Retail Trade for North Dakota. U. S. Department of Commerce, Washington, D.C.

_____. 1977. Census of Selected Services. U. S. Department of Commerce, Washington, D.C.

_____. 1977. Census of Wholesale Trade for North Dakota. U. S. Department of Commerce, Washington, D.C.

_____. 1972. County and City Data Book. U. S. Department of Commerce, Washington, D.C.

_____. 1979. Population Estimates and Projections, Series P-25 and P-26, No. 78-34 and No. 847. U. S. Department of Commerce, Washington, D.C.

Bureau of Economic Analysis. 1979. Survey of Current Business. Vol. 59, No. 4 (April, 1979). U. S. Department of Commerce, Washington, D.C.

Cernohous, L. 1979. The Value of Wetlands for Flood Control. U. S. Fish and Wildlife Service, Bismarck Area Office, Bismarck, N.D. 7 pp.

Cole, Kenneth W. 1968. The Forest River Survey, 1967. Report Prepared by the University of North Dakota, Grand Forks for the U. S. Army Corps of Engineers, St. Paul, MN.

Copes, Fredrick A. and Richard A. Tubb. 1966. "Fishes of the Red River Tributaries in North Dakota". Contributions of the Institute for Ecological Studies. The University of North Dakota, Grand Forks, N.D. 26 pp.

Cvancara, A. M. 1970. "Mussels (Unionidae) of the Red River Valley in North Dakota and Minnesota, U.S.A.", Malacologia. 10(1):57-92.

Directory of North Dakota Manufacturing, 1978-1979. North Dakota Business and Industrial Development Department. Bismarck, N.D. 140 pp.

Farmer, C. E., L. M. Winczewski, K. T. Killingbeck, G. E. Johnson, R. D. Ludtke, R. H. Pilatzke, A. Carmichael, J. P. Jorgenson. 1974. Environmental Impact Assessment of the Homme Dam and Reservoir, North Dakota. Research Report No. 7. Institute for Ecological Studies, University of North Dakota, Grand Forks, N.D. 189 pp.

Hewes, Gordon. 1948. "Early Tribal Migrations in the Northern Great Plains", Plains Archeological Conference Newsletter. 1(4):49-61 (July 15, 1948).

International Pembina River Engineering Board. 1964. Joint Investigation for Development of the Water Resources of the Pembina River Basin, Manitoba and North Dakota. Vol. 1-Main Report to the International Joint Commission, Canada and the United States. St. Paul, MN. 80 pp. plus Exhibits.

Johnson, Elden. 1973. The Arvilla Complex. Minnesota Prehistoric Archeology Series No. 9. Minnesota Historical Society, St. Paul, MN.

_____. 1962. "The Prehistory of the Red River Valley", Minnesota History. 38(4):157-165.

Kannowski, P. B. 1971. Environmental Aspects of Two Water Management Alternatives in the Park River Subbasin, North Dakota. Research Report No. 1. University of North Dakota, Grand Forks, N.D. 60 pp.

Kantrud, Harold A. 1973. "Preliminary List of Natural Areas in North Dakota", The Prairie Naturalist. Vol. 5, No. 3. pp. 33-39.

Kuchler, A. W. 1964. Potential Natural Vegetation of the Conterminous United States. American Geographical Society.

Loendorf, Lawrence, and Jane Loendorf. 1975. The Results of the Archaeological Survey of Dam #5, Middle Branch of the Park River. A Report Prepared by the University of North Dakota for the U. S. Soil Conservation Service. Grand Forks, N.D.

Lutke, R. L., K. R. Stamm, J. E. Bowes, II, R. D. Kingsbury. 1971. Social and Economic Considerations for Water Resources Planning in the Park River Subbasin, North Dakota. Research Report No. 2. University of North Dakota, Grand Forks, N.D.

McKenna, Michael G. and Robert W. Seabloom, editors. 1979. "Endangered, Threatened, and Peripheral Wildlife of North Dakota". Research Report No. 28. University of North Dakota, Grand Forks, N.D. 62 pp.

North Central Planning Council. 1977. Resource Conservation and Development Plan. Devils Lake, N.D. 94 pp.

North Dakota Aeronautical Chart. 1979. North Dakota Aeronautics Commission.

North Dakota Crop and Livestock Statistics. 1979. North Dakota State University Agricultural Experiment Station. Fargo, N.D. 87 pp.

North Dakota Employment Statistics. 1977. Employment Security Bureau. Bismarck, N.D.

North Dakota Railroad Map. 1972. Public Service Commission, State of North Dakota.

North Dakota State Department of Health. 1964. Chemical Analyses of Municipal Waters in North Dakota.

_____. 1980. Water Supply Data Package.

North Dakota State Department of Health. 1978. North Dakota Statewide 208 Water Quality Management Plan, Executive Summary.

North Dakota State Highway Department Maps. 1977. Cavalier County, Pembina County, Walsh County.

North Dakota State Outdoor Recreation Agency. 1975. North Dakota State Comprehensive Outdoor Recreation Plan.

North Dakota State Parks and Recreation Department. 1979. Inventory of North Dakota Outdoor Recreation Facilities.

North Dakota State Planning Division. 1977. Improving Land Use and Resource Development Planning In North Dakota: A Report to the North Dakota Natural Resources Council. Bismarck, N.D. 95 pp.

North Dakota State Soil Conservation Committee. 1972. Land Use and Assessment and Needs. Public Law 92-500, Federal Water Pollution Control Act Amendments of 1972, Section 208. Non-Point Source Task Force, Bismarck, N.D. 20 pp.

North Dakota State Water Commission. 1968. North Dakota Interim State Water Resources Development Plan. Bismarck, N.D. 240 pp.

_____. 1968. North Dakota Interim State Water Resources Development Plan, Appendix D: An Economic Analysis of Water Development for Irrigation in North Dakota. Bismarck, N.D. 90 pp.

_____. 1977. North Dakota Water Laws. Bismarck, N.D. 345 pp.

Omaha District Corps of Engineers. 1977. Water Resources Development in North Dakota. Omaha District Corps of Engineers, Omaha, NE. 48 pp.

Red River Regional Planning Commission. 1977. Background Studies for Planning, North Dakota Substate Planning Region IV, Vol. I.

_____. 1977. Land Use Planning Element, North Dakota Substate Planning Region IV, Vol. II.

_____. 1978. Regional Housing Element, North Dakota Substate Planning Region IV.

Robinson, Elwyn B. 1966. A History of North Dakota. Lincoln: University of Nebraska Press.

Saylor, Stanley. 1975. "DhLb1: Early Period Occupation near Glacial Lake Agassiz, Southeast Manitoba", Plains Anthropologist 20(70):241-252.

Shewman, Frederick C. and the North Dakota State Department of Health, no date. Red, Souris, Devils Lake Basins Water Quality Management Plan.

Soil Conservation Service. 1980. Draft Planning Report on the North Branch Park River Watershed. Walsh, Cavalier, and Pembina Counties, North Dakota. U. S. Department of Agriculture.

_____. No date. Floodwater Retarding Dam Site Investigations, Red River Basin, North Dakota. Bismarck, N.D.

_____. 1979. North Dakota Watershed Annual Report. Bismarck, N.D.

_____. 1964. Watershed Work Plan for Watershed Protection and Flood Prevention, Willow Creek - Park River Watershed, Cavalier, Pembina and Walsh Counties, North Dakota. U. S. Department of Agriculture, Bismarck, N.D.

_____. 1965. Work Plan for Watershed Protection and Flood Prevention, Middle Branch - Park River Watershed, Cavalier, Pembina and Walsh Counties, North Dakota. U. S. Department of Agriculture, Bismarck, N.D.

Souris-Red-Rainy River Basins Commission. 1972. Souris-Red-Rainy River Basins Comprehensive Study. Souris-Red-Rainy River Basins Commission, Moorhead, MN. 8 vols.

South Central Dakota Regional Council. 1979. Resource Conservation and Development Plan. Jamestown, N.D. 82 pp.

Stewart, R. E. 1975. Breeding Birds of North Dakota. Tri-College Center for Environmental Studies, Fargo, N.D. 295 pp.

St. Paul District Corps of Engineers. 1979. Development of Nonstructural Alternatives. St. Paul District Corps of Engineers, St. Paul, MN. 83 pp.

_____. 1975. Final Environmental Impact Statement: Flood Control at Grafton, Park River, North Dakota. St. Paul District Corps of Engineers, St. Paul, MN.

_____. 1979. Future Growth of Agricultural Damages, Red River Basin (Memo). St. Paul District Corps of Engineers, St. Paul, MN. 4 pp.

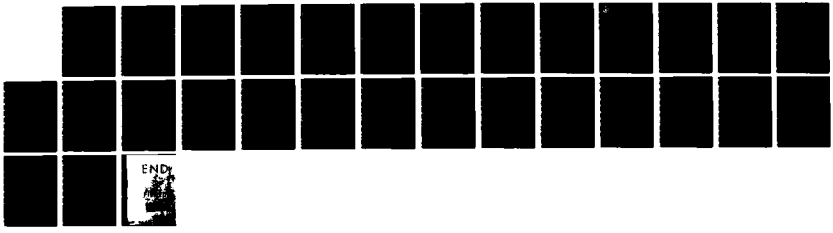
_____. 1980. Future Growth of Other (Noncrop) Agricultural, Urban, and Transportation Damages, Red River Basin. (Memo). St. Paul District Corps of Engineers, St. Paul, MN. 2 pp.

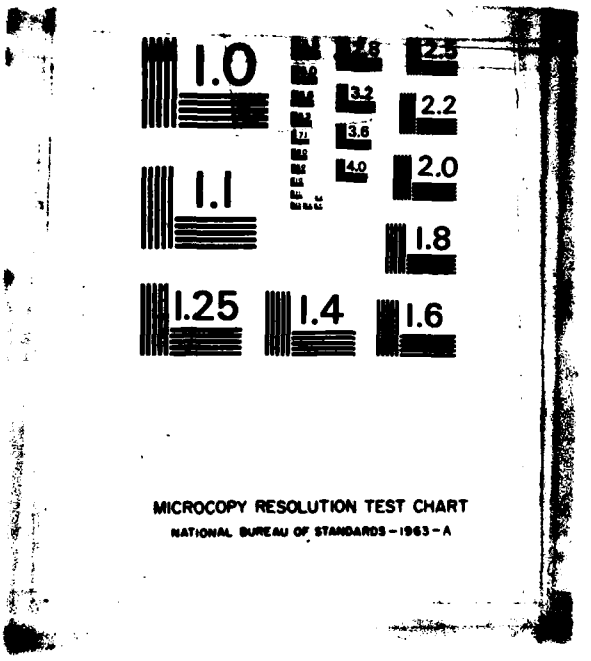
_____. No date. General Economic Evaluation Procedures For Farmstead Ring Levees and Related Data. St. Paul District Corps of Engineers, St. Paul, MN.

_____. 1976. Interim Survey Report For Flood Control and Related Purposes, Park River Subbasin, North Dakota. St. Paul District Corps of Engineers, St. Paul, MN.

AD-A140 789 RED RIVER OF THE NORTH RECONNAISSANCE REPORT: PARK RIVER SUBBASIN(U) GULF SOUTH RESEARCH INST BATON ROUGE LA DEC 80 DACW37-80-C-0017 2/2

UNCLASSIFIED F/G 8/8 NL




1.0
1.1
1.25
1.4
1.6
2.5
2.2
2.0
1.8
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS - 1963 - A

St. Paul District Corps of Engineers. 1974. Interim Survey Report for Flood Control and Related Purposes, Park River Subbasin. Meeting with State Water Commission and Grafton Regarding Local Support for Project. St. Paul District Corps of Engineers, St. Paul, MN. 6 pp.

_____. 1978. Minnesota Emergency Levee Inventory. St. Paul District Corps of Engineers, St. Paul, MN.

_____. 1975. Mississippi, Souris, Red River Basin Post Flood Report, 1975. St. Paul District Corps of Engineers, St. Paul, MN. 90 pp.

_____. 1980. Phase I-General Design for Flood Control and Related Purposes, Sheyenne River, North Dakota. St. Paul District Corps of Engineers, St. Paul, MN.

_____. 1970. Plan of Survey for an Interim Survey for Flood Control and Related Purposes. St. Paul District Corps of Engineers, St. Paul, MN.

_____. No date. Post Flood Reports, Souris and Red River of the North Basins, 1969, 1974, 1975, 1978, and 1979. St. Paul District Corps of Engineers, St. Paul, MN.

_____. 1973. Red River of the North Basin Plan of Study. St. Paul District Corps of Engineers, St. Paul, MN.

_____. 1979. Red River of the North and Souris River Post Flood Report, 1979. St. Paul District Corps of Engineers, St. Paul, MN. 100 pp.

_____. 1979. Section 205 Detailed Project Report for Flood Control, Snake River Below Warren, Minnesota. St. Paul District Corps of Engineers, St. Paul, MN.

_____. 1970, 1971. Water Management Alternatives for North Dakota's Park River Basin - Water Resources Fact Sheets. St. Paul District Corps of Engineers, St. Paul, MN.

_____. 1979. Water Resources Planning and Development in North Dakota; A Status of Corps of Engineers Studies. St. Paul District Corps of Engineers, St. Paul, MN. pp. 19-20.

Strong, William D. 1941. "From History to Prehistory in the Great Northern Plains", Smithsonian Miscellaneous Collections. 199:353-394.

U. S. Army Corps of Engineers, Institute for Water Resources. 1979. Preliminary Inventory of Hydropower Resources, National Hydrolectic Power Resources Study, Mid-Continent Region, N.D. 13 pp.

U. S. Fish and Wildlife Service. 1979. Fee and Easement Interest in Real Property, North Dakota, as of August 31, 1979. Bismarck, N.D.

U. S. Fish and Wildlife Service. 1979. Terrestrial and Aquatic Resources Package for Minnesota Tributaries to the Red River of the North. Ecological Services Office, St. Paul, MN.

_____. 1980. Terrestrial Resources Package for North Dakota Tributaries to the Red River of the North. Area Office, Bismarck, N.D.

_____ and North Dakota Game and Fish Department. 1978. "1978 Stream Evaluation Map". Bismarck, N.D.

U. S. Geological Survey. 1979. Water Resources Data for North Dakota, Water Year 1978. Bismarck, N.D.

Wedel, Waldo. 1961. Prehistoric Man on the Great Plains. University of Oklahoma Press, Norman, OK.

Willenbring, R. E., and W. T. Barker. Undated. The Vascular Flora of Pembina County, North Dakota. Reprinted from The Prairie Naturalist, Vol. 3, Nos. 3 and 4, pp. 80-104.

Willis, D. W. 1977. A List of Vertebrates of Northeastern North Dakota. Special Report No. 1. Institute for Ecological Studies, University of North Dakota, Grand Forks, N.D. 20 pp.

Work Progress Administration. 1950. North Dakota: A Guide to the Northern Prairie State. New York: Oxford University Press.

Appendix A
FLOODPLAIN DELINEATION

Appendix A

FLOODPLAIN DELINEATION

Prior to this study, no attempt was made to publish even a generalized delineation of the entire floodplain. In undertaking this task, the present study utilized all known sources to provide the best available data for generalized delineation of the subbasin at a scale of 1:250,000. Principal sources were: USGS Flood Prone Area Maps (scale 1:24,000), Corps of Engineers photomosaics of the 1979 flood, Federal Insurance Administration flood maps, published secondary sources, U. S. Geological Survey (USGS) 7 1/2 minute topographic maps, and other sources, including derived data where necessary.

The Flood Prone Area Maps published by the USGS provided detailed and highly accurate information for the area mapped. Two sheets covering the area near the city of Park River and two sheets on the main stem Red River comprised the coverage available.

The floodplain in the eastern one-third of the subbasin was taken largely from photomosaics at a scale of one inch equals 3,300 feet. Some portions involved a fair amount of interpretation because of clouds and/or light reflection, but in general the mosaics proved quite useful in delineating the 100-year level.

Federal Insurance Administration Flood Hazard Boundary Maps and Flood Insurance Rate Maps provide only limited coverage for selected incorporated areas in the North Dakota portion of the Red River Basin. Maps for the communities of Crystal in Pembina County and Grafton, Hoople, and Edinburg in Walsh County were utilized. The respective counties entered the emergency flood program in 1974 and 1978, but do not as yet have published county maps.

Secondary sources, such as the Souris-Red-Rainy River Basins Type II Study, were also utilized. Published floodplain descriptions and acreage estimates in the 1964 Willow Creek-Park River Watershed and 1966 Middle Branch-Park River Watershed work plans contained helpful information regarding the location and extent of the floodplain. USGS 7 1/2 minute topographic maps of relevant areas were also available for consideration.

Appendix B

INVENTORY OF OUTDOOR RECREATIONAL FACILITIES, PARK RIVER SUBBASIN

Appendix B

INVENTORY OF OUTDOOR RECREATIONAL FACILITIES[1]
PARK RIVER SUBBASIN

Number	Name	Administration	Location	Acres	Campgrounds[2]	Playground	Athletic Field[3]	Golf Courses[4]	Boat Ramps	Picnic Tables	Beach	Pool	Trails[5]
[1]	North Salt Lake WMA	State	Walsh Co. 15856W03	95.0									
[2]	Charles C. Cook WMA	State	Walsh Co. 15856W17 Edinburg	324.0									
1	St. Thomas Park	Municipal	Pembina Co. St. Thomas	24.0		1	1						
2	Grafton Park	Municipal	Walsh Co. Grafton	20.0		1	2			30		1	
3	Grafton Outdoor Recreation Complex	Municipal	Walsh Co. Grafton	42.0			5						
4	Walsh Co. Gun Club	Private	Walsh Co. Park River	40.0									
5	Spillway Overlook	Federal	Walsh Co. Homme Dam	17.0					1	23			
6	West Bay Landing	Federal	Walsh Co. Homme Dam	229.0	7					6			
7	Homme Dam and Recreation Area	State	Walsh Co. Homme Dam	405.0	25	1			2	20	1		
(1)	Grafton Golf Course	Municipal	Walsh Co. Grafton	70.0				9					
(2)	Park River Golf Club	Private	Walsh Co. Park River	35.0				9					

[1] Facilities included are those with 15 or more acres.

[2] Number of campsites.

[3] Number of fields.

[4] Number of holes.

[5] Number of miles.

Source: North Dakota State Parks and Recreation Department, Inventory of North Dakota Outdoor Recreation Facilities, 1979.

Gulf South Research Institute.

Appendix C
COMMENTS

Appendix C
COMMENTS

The purpose of this subbasin report was to provide an overview of the water and related resource problems and needs and to assess potential solutions. Toward this end, draft copies of this report were circulated to Federal, State, and local agencies and comments were sought.

This review resulted in complete and factual documentation. Thus, the study should serve as a building block for the timely completion of future water resource efforts within the subbasin. Further cooperative efforts are, however, needed to evaluate these tentative results and to develop potential solutions.

A distribution list and copies of the comments made with respect to the draft report are included as part of this appendix. Comments that resulted in specific modifications to the draft text are marked by an asterisk.

DEPARTMENT OF THE ARMY
ST PAUL DISTRICT, CORPS OF ENGINEERS
1135 U S POST OFFICE & CUSTOM HOUSE
ST PAUL, MINNESOTA 55101

REPLY TO
ATTENTION OF:

NCSED-PB

28 August 1980

Mr. Mike Liffmann
Project Manager
Gulf South Research Institute
8000 GSRI Avenue
Baton Rouge, Louisiana 70808

Dear Mr. Liffmann:

The draft Park River subbasin report was distributed for review and comment. Most of the reviewers have sent their comments to us.

a. Inclosure 1 includes letters from various Federal and State agencies. Other letters, when received, will be provided under separate cover.

b. Inclosure 2 is the general office comments that need to be considered when preparing the final Park River subbasin report and the remaining subbasin reports.

c. Inclosure 3 identifies specific office concerns that are applicable to the final Park River subbasin report.

If you have any questions on our comments or proposed modifications, please contact us.

Sincerely,

Louis E Kowalski

LOUIS E. KOWALSKI
Chief, Planning Branch
Engineering Division

3 Incl
As stated

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. Box 1458, Bismarck, ND 58502

July 31, 1980

Colonel William W. Badger
District Engineer
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Badger:

We have reviewed the drafts of the Park River and Forest River Subbasins, that concern the Red River of the North reconnaissance study, enclosed with your undated letter that we received July 21, 1980.

We have the following comments:

Park River Subbasin (draft report) July 1980

* 1. Page 1, 3rd paragraph - It is difficult to understand how the Park River Subbasin, located in northeastern North Dakota, can be located in the southeastern Minnesota portion of the Red River basin.

2. Page 2, Items 1 and 2 - These two plans, in addition to describing flood protection plans, are authorization documents. Installation of the Willow Creek plan has been completed. Four of the five floodwater retarding dams have been installed in the Middle Branch Park River Watershed. Unless one reads Page 51 of the report, implementation would not be known. The other documents listed on Pages 1 and 2 are not implementation documents and by association, the reader could conclude the work plans are similar.

* 3. Page 5, last paragraph - Valley width 100 feet in the glacial lake bed area? The channel top width approaches or exceeds 100 feet. Also, see first full paragraph, Page 9, that states the flood plain is 2 1/2 miles in width. Surely the flood plain is in the valley?

* 4. Page 12, lines 10, 11, and 12, and the last sentence in the first full paragraph - The statements from the SCS 1980 report are correct but are somewhat out of context. The Service recognizes these needs from a wildlife and/or environmental consideration. As shown, it is implied that these needs must be satisfied. These proposals might better be classified as desires.

* 5. Page 15, Public Perception of Problems and Solutions - It is doubtful if the public perception of problems is reasonably well defined because the Corps of Engineers conducted studies and held meetings or

because the subbasin has been organized into watershed districts. The public perception of problems may be reasonably well defined by the Corps of Engineers as a result of study, etc. Water Management Districts are organized on a county or partial county basis in North Dakota. We are not aware of any watershed districts with legal status in North Dakota at this time.

* 6. Page 30, last paragraph - The wording in the first two sentences indicates the stream classification is as shown on the 1978 Stream Evaluation Map, State of North Dakota. The fourth sentence states "One of the primary reasons for this classification is that these reaches provide the water supply for numerous reservoirs and municipalities in the area." We know of only one reservoir - we question the word numerous. The fact that streams provide water for municipalities is not listed as criteria for Class III classification.

* 7. Page 38, Woodlands - We doubt if woodlands are significant because they have been cleared to a great extent for other land uses. Within the subbasin, grassland was a much more significant source for other land uses.

* 8. Page 51, Item 1 - The North Salt Lake WMA was developed as a watershed project measure and should be included in this item.

9. Page 52 - The Figure title should be changed to Existing and Authorized Flood Control Measures, this would be in agreement with the map legend.

10. Page 54, top of page - There are Soil Conservation Districts in each county in North Dakota that provide technical assistance for land treatment through the Soil Conservation Service.

* Total treatment of all acres in the subbasin would reduce average annual flood damages approximately 5 percent.

During times of flooding drainage ditches are full of water and overflowing (as are river channels). Thus maximum use is being made of this storage capacity.

The term natural areas or natural storage areas needs to be defined.

* 11. Page 54, Adequacy of Existing Measures, first paragraph - Floodwater retarding structures in the Willow Creek-Park River Watershed are designed to control a 25-year frequency runoff from the contributing area. Channel improvements design is based on the M curve and approximates a 5 to 8 frequency capacity. The total watershed is not provided with 4 percent (25-year) flood protection. The average annual floodwater damages were calculated to be reduced 72 percent.

* 12. Page 57, Item 3 - The Planning Report, North Branch Park River Watershed, March 1980, states on the first page of Section VIII, Summary "The evaluation of nonstructural and structural measures for flood damage reduction did not produce an economically feasible alternative plan for the watershed. Economic feasibility is a requirement for

a viable watershed work plan to be funded under PL-566. Planning has been terminated thus, this item does not satisfy the resource management objectives of this section.

13. Page 63, Alternative 3 - We would be interested in how the 0.99 B/C ratio was computed. The March 1980 Planning Report, North Branch Park River Watershed displays the results of our analysis. The most effective alternative we studied was nonstructural, a change of land use in the flood prone area from cash crops to grassland. The B/C ratio computed to 0.80. The most effective structural alternative provided a B/C ratio of 0.60. Also, see Page 66, first sentence that states ".....would provide an as yet undertermined amount of flood protection...." If this is the case, we fail to understand how a B/C ratio of 0.99 can be computed.

Forest River Subbasin (Draft Report) July 1980

1. Page 1 - See comment No. 1 for Park River Subbasin.

2. Page 1, Item 2 - The watershed work plan in addition to describing a plan is also the authorizing document. The plan measures have been installed.

3. Page 2, Item 3 - Same comment as for Item 2 above except the project is under construction.

4. Page 2, Item 4 - Same comment as for Item 2 above except project is inactive with 25.8 miles of channel work installed.

5. Page 11, Recreation Problems - The Fordville Dam and recreation area will be open for public use in 1981. This will be the eighth reservoir in the subbasin and recreation facilities are provided that will contribute to recreational opportunities.

6. Page 15 - First sentence states the 3 existing dams.... Page 11, under Recreation Problems indicates 7. Seven is also indicated in the third paragraph, Page 15. We believe seven is the correct number.

7. Page 15, Public Perception of Problems and Solutions - We question perceptions not being adequately defined in the absence of the Corps of Engineers' conducted public meetings? See comment No. 5 for Park River Subbasin regarding watershed districts.

8. Page 21, Land Use, second sentence - 0.7 percent of total land area is water and marsh? Shouldn't this read "Only 0.7 percent of the subbasin area is water and marsh."

9. Page 48, Figure V - The existing reservoirs are operated and maintained by the Water Management Districts. They are not Corps' reservoirs. They were designed by the Soil Conservation Service.

10. Page 49, bottom of page and top of Page 50 - See comment No. 10 for Park River Subbasin.

We appreciate the opportunity to comment on these draft documents.

Sincerely,

Charles E. Mumma
Assistant State Conservationist (WR)

[redacted]
701-[redacted]
[redacted]
North Dakota

September 8, 1980

Col. William W. Badger, District Engineer
St. Paul District Corps of Engineers
1135 U.S. Post Office & Customhouse
St. Paul, MN 55101

RE: Red River Mainstem Study - SWC Project #1701

Dear Col. Badger:

This letter is to provide comments on the draft reports for the Goose, Turtle, Park, Elm, Rush, and Forest River Subbasin reports for the Red River of the North Reconnaissance Study. Although, the reports are satisfactory, it is recognized that they are specific to flood control problems. As stated previously, it is hoped that solutions for total water management can be addressed in the final basin report.

In reviewing the Goose River Subbasin Report, mention was found of the water supply problems experienced by the City of Mayville. Since lack of water by the city has been a significant problem for Mayville in recent years, it is believed that more emphasis should be placed on describing this problem. In addition, alternatives should be considered for improving Mayville's water supply. On page 49 of the report, there is discussion of flood control planning for the subbasin. Since the State Water Commission has authority in flood control planning, this agency should be included in the discussion. There appears to be an error on the map on page 51, in that it shows the subbasin to have 10 existing Corps of Engineers reservoirs. On page 52 of the report mention is made of the use of present drainage ditches for flood water storage. It is questioned whether or not this is practical and feasible.

The Turtle River Subbasin Report contains an error on page 14, where it is stated that the Upper Turtle River Watershed Work Plan was published by the Minnesota Soil Conservation Service. As in the Goose River report, mention should be made that the StateWater Commission should also be involved in additional efforts in flood control planning. This is discussed on page 44 of the Turtle River report. In the formulation of alternative measures section, it should be mentioned that for alternatives 1, 2, and 3, that other agencies such as the State Water Commission or water management boards could be the implementing agency.

* In the Park River Subbasin Report, the water supply section states that the City of Grafton relies solely on the Park River for its water. This is not true, since the City of Grafton has recently completed a pipeline to the Red River. Again, the State Water Commission should be identified as an agency that has the authority for flood control planning for this river basin. A recent study of the flood problem at Grafton by the State Water Commission revealed that a snagging and clearing project on the Park River downstream from Grafton would reduce the flood damage in Grafton considerably. Consideration should be given to including snagging and clearing of the Park River in this vicinity as another structural alternative.

The irrigation section of the Elm River Subbasin Report states that very limited amounts of acreage in the basin are being irrigated. The identification of the Page aquifer and increased interest in irrigation has resulted in an increase in irrigation in the basin in recent years. In considering the systems that have been developed and the interest in developing additional systems, it can be stated that substantial amounts of acreage in the subbasin are being irrigated.

The Rush River Subbasin Report states that the subbasin includes portions of three water management districts. Although this may be true since legal descriptions are used to describe the water management districts, for the most part it is commonly accepted that all of the Rush River Subbasin is within the jurisdiction of the Rush River Water Management Board. Again, it must be stated that the State Water Commission has jurisdiction for flood control planning for the subbasin along with the other federal and local entities.

The water supply section of the Forest River Subbasin Report states that water supply in the subbasin is adequate. This is true from a quantity standpoint, although the City of Minto is in serious need of a new water supply dam, since their existing dam is damaged beyond repair. As stated before, mention of State Water Commission authority for flood control planning should be added to the report.

Oftentimes in the reports, GSRI is mentioned as a source for data. If this is updated data from other reports, the method for updating the data should be described. Data from the published county ground water reports could be used for ground water aquifer identification in the subbasin.

Sincerely,

David A. Sprynczynatyk, P.E.
Director of Engineering

DAS:smh

United States Department of the Interior
FISH AND WILDLIFE SERVICE
AREA OFFICE—NORTH DAKOTA
1500 CAPITOL AVENUE
P.O. BOX 1897
BISMARCK, NORTH DAKOTA 58501

SEP 1 6 1980

Colonel William W. Badger, District Engineer
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Re: Red River Mainstem (CE)

Dear Colonel Badger:

This provides U.S. Fish and Wildlife Service (FWS) comments on the Draft Reconnaissance Report recently compiled by Gulf South Research Institute for Park River Subbasin in Walsh, Pembina, and Cavalier Counties, North Dakota.

As expressed in our comments on previous subbasin reports, our concerns are associated with the woodland, grassland, wetland, riverine and riparian floodplain habitats that remain within the Park River Subbasin. Most of the grassland, woodland and wetland habitat in the Park River Subbasin has been converted to agricultural uses. Page 25 states, "Characteristic prairie vegetation is confined primarily to roadsides, railroad rights-of-way, fencelines, deforested riverbanks and slopes, abandoned farmlands, country churchyards and cemeteries, and some grassland pastures". Native woodlands are now found as narrow riparian communities along streams or around lakes, in upland areas where the rugged terrain has prevented total conversion of lands to either cropland or pasture, and as shelterbelts or windbreaks. Most wetlands in the subbasin have been eliminated except for prairie potholes remaining in the western portion of the subbasin. We agree with the statements on pages 12, 38, 39 and 40 that these remaining grassland, woodland, and wetland habitat types are significant and need to be protected, conserved and enhanced within the subbasin.

The report addressed three structural alternative measures that have been identified to date to meet the studies flood damage reduction objective. The report indicated, however, that only two of these measures have a favorable B/C ratio and appeared to be economically feasible. These measures and our comments relative to each are as follows:

Alternative 1 - Combination Urban Levee and Flood Bypass Channel for Grafton

This alternative will provide flood protection for the city of Grafton, but will not reduce flood damages in the rest of the subbasin. It consists of an 8.7-mile earthen ring levee and 2.9-mile flood bypass channel north of the levee. This alternative has been authorized for construction by Congress, which appropriated funds to began the Phase I General Design Memorandum in Fiscal Year 1980. This project will provide protection for Grafton against the 1 percent (100-year) frequency flood. We do not anticipate any significant adverse environmental impacts due to this alternative, provided that mitigation measures recommended by the FWS are accepted by the Corps of Engineers.

Alternative 2 - Farmstead Levees

We do not anticipate any adverse environmental impacts due to this alternative providing the dikes are not constructed through wetland areas and impacts to existing woodland vegetation are avoided to the extent possible.

Alternative 3 - North Branch Park River Watershed

The primary purpose of this project was to formulate a water management program that would reduce the flooding of agricultural land found in the North Branch Park River Watershed. However, The evaluation of nonstructural and structural measures for flood damage reduction did not produce an economically feasible alternative plan for the watershed. In April 1980, the Soil Conservation Service terminated watershed planning assistance authorized under the authority of PL-566 for the North Branch Park River Watershed.

Generally, we believe the draft report was well written and sets forth a good overview of the water and related land resources and problems, and possible solutions to some of these problems within this subbasin of the Red River of the North. We suggest, however, that the following changes be made in the report:

* 1. Page 1, third paragraph, first sentence - We suggest this sentence be changed to read, "The Park River Subbasin is a water resource planning unit located in the northern North Dakota portion of the Red River Basin".

* 2. Page 2 under Item 6 - Change "Paul W. Kennowski" to read "Paul B. Kannowski".

3. Page 9, first sentence - We suggest this sentence be deleted. The sentence, "No areas of associated marshland are found within the subbasin" is misleading and contradictory to Table 9 found on page 41. Table 9 indicates that there are 59,578 acres of wetlands in the Park River Subbasin.

* 4. Page 28, second paragraph, third sentence - Common furbearers listed should also include muskrat.

* 5. Page 36, first paragraph, last sentence - We suggest this sentence be changed to read, "Species found in the area include waterfowl, shorebirds, upland game birds, deer, furbearers and nongame birds".

* 6. Page 36, second paragraph, first sentence - We suggest this sentence be changed to read, "Homme Lake, located 17 miles west of Grafton, provides the only significant fishing resource in the subbasin".

* 7. Page 37, Figure III - The locations for the two WMA's listed have been incorrectly placed on the map. We have attached a copy of Figure III indicating the approximate locations of these WMA's (Attachment 1).

* 8. Page 38, first paragraph, first sentence, under the heading "Water" - To be consistent with the statement on page 23, we suggest .2 percent be changed to read 2 percent.

* 9. Page 42, first paragraph, under the heading "Waterfowl Production Areas" - Change this paragraph to read as follows:

> Waterfowl Production Areas (WPA's) are wetland areas that the Fish and Wildlife Service (FWS) has either acquired through fee title, or obtained an easement interest in, to preserve valuable breeding, nesting, and feeding habitat for migratory waterfowl. These wetland areas are purchased, or an easement interest obtained, with funds received from the sale of migratory bird hunting and conservation stamps (Duck Stamps). These WPA's are significant because they provide the public with a great variety of wildlife-oriented recreational opportunities, as well as providing valuable habitat for migratory waterfowl and many other forms of wildlife. FWS is responsible for the compatibility determinations (uses) and the issuance and denial of permits involving these lands. WPA's acquired in fee title are managed for optimum wildlife production, particularly waterfowl. On easement WPA's, the rights acquired are limited to the burning, draining and filling of wetland basins and the right of access. All other property rights remain with the landowners. The approximate locations of the WPA's acquired in fee within the subbasin are shown in Figure IV. Total acres of these WPA's, fee and easement, within Cavalier, Pembina and Walsh Counties, North Dakota, is given in Table 10.

* 10. Page 43, Figure IV - Place fee tracts in parenthesis after the legend. We believe at least three additional WPA's in Walsh County should also be identified by a dot in Figure IV. We have attached a copy of Figure IV indicating the approximate locations of these WPA's (Attachment 2).

* 11. Page 44, first paragraph, under heading "Other Important Species" - This section should also include the northern waterthrush, a peripheral avian specie known to exist locally in Walsh County.

* 12. Page 44, first paragraph, first sentence, under heading "Rare and Unique Plants" - Remove "(no date)" in parenthesis and insert "(1976)".

13. Page 61, last paragraph - We suggest the following sentence be added to this paragraph:

> Recommendations 7, 8 and 11 on pages 68-69 in Section XI addresses some of these nonstructural measures.

* 14. Page 68 - Add riparian woodlands to Recommendation No. 2.

* 15. Page 71, Bibliography Citation No. 1 should read as follows:

> Barker, William T., Gary Larson and Richard Williams. 1976. "Rare and Unique Plants of North Dakota". Department of Biology, Agricultural Experiment Station, North Dakota State University, Fargo, North Dakota.

* 16. Page 76, Bibliography Citation No. 2 should read as follows:

_____, 1980. Terrestrial Resources Package for North Dakota. Tributaries to the Red River of the North. Area Office, Bismarck, North Dakota.

These comments have been prepared under the authority of and in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and other authorities mandating Department of the Interior concern for environmental values. They are also consistent with the intent of the National Environmental Policy Act of 1969.

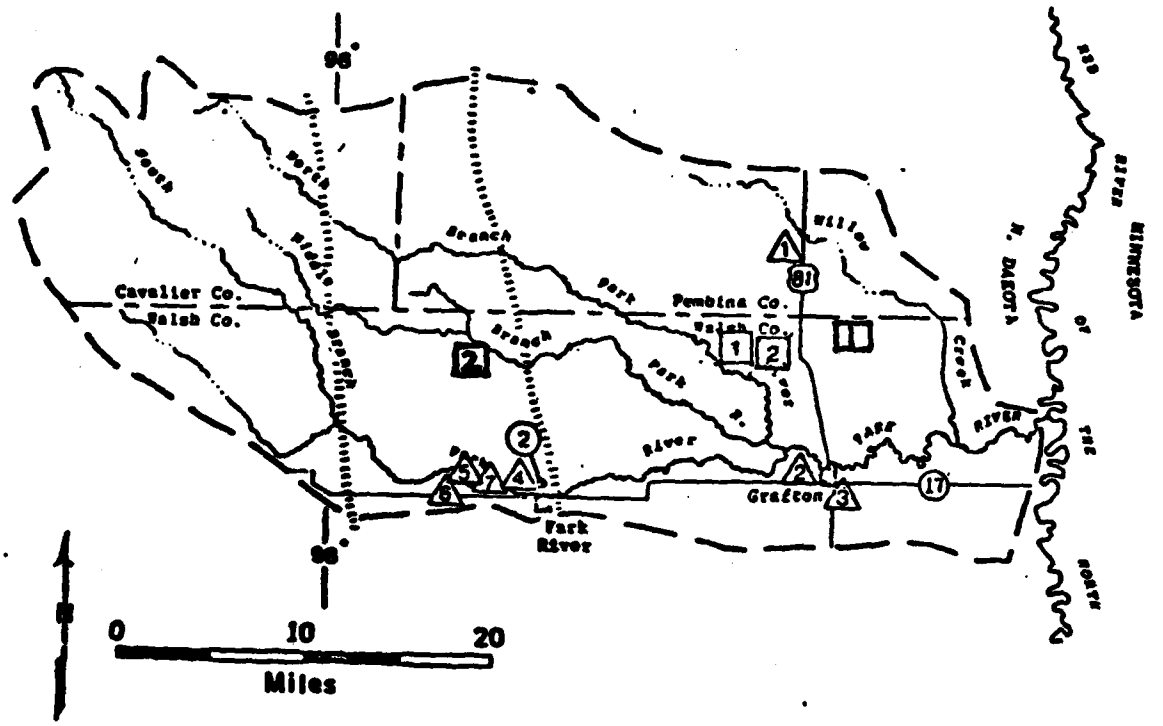
The opportunity to review and comment on the Draft Reconnaissance Report of the Park River Subbasin is appreciated.

Sincerely yours,

for Gilbert E. Key
Area Manager

Attachments (2)

ATTACHMENT 1



□ EXISTING WILDLIFE AREAS

1 North Salt Lake WMA
2 Charles C. Cook WMA

△ EXISTING RECREATION AREAS

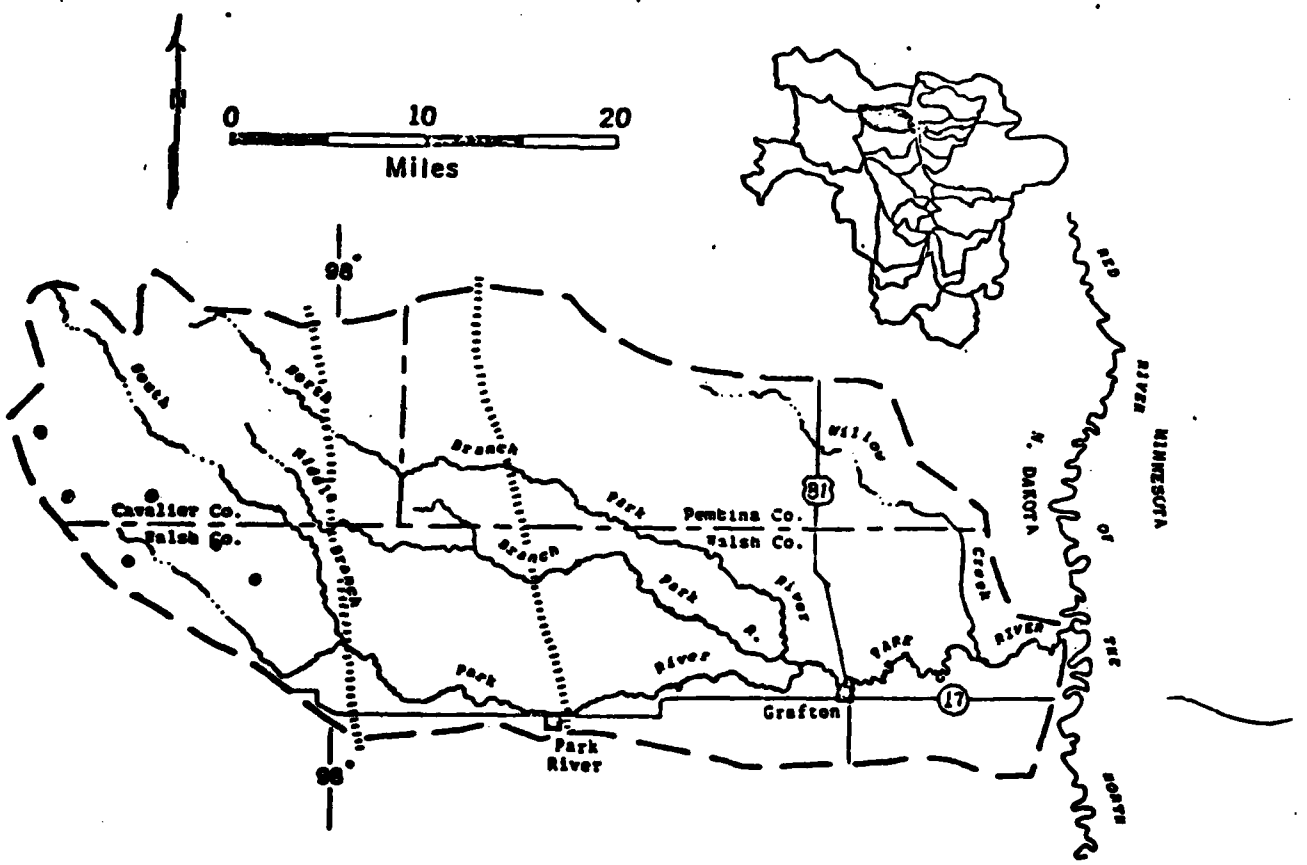
1 St. Thomas Park
2 Grafton Park
3 Grafton Outdoor Recreation Complex
4 Walsh County Gun Club
5 Spillway Overlook
6 West Bay Landing
7 Homme Dam and Recreation Area

○ OTHER EXISTING RECREATION AREAS

1 Grafton Golf Course
2 Park River Golf Club

Source: Gulf South Research Institute.

Figure III. RECREATIONAL RESOURCES



● WATERFOWL PRODUCTION AREAS (Fee Tracts)

Waterfowl Production Areas

*The exact locations and numbers of ~~Wildlife Management Areas~~ are on file at the U.S. Fish and Wildlife Service, Area Office, Bismark. No copies of these maps have been published or released but can be reviewed at the above office.

Source: State Comprehensive Outdoor Recreation Plan, 1975; U.S. Fish and Wildlife Service 1980.

Figure IV. WATERFOWL PRODUCTION AREAS

U.S. Army Corps of Engineers
North Central Division
Comments on the
Draft Park River Subbasin Report
(July 1980)

1. Page 7 - Figure II is a poor map. There needs to be a legend which clearly describes the patterning used to delineate the 100-year floodplain, marshy areas, etc.

2. Page 10 - The 1979 flood was a major flood. The frequency or probability of the 1979 flood should be identified and included in the discussion of the event.

3. Page 53 - The explanation of nonstructural measures should be modified to include:

Nonstructural measures modify the susceptibility of land, people, and property to damage or losses. In addition they modify the impact of flooding upon people and communities. Nonstructural measures do not attempt to modify the behavior of floodwaters.

4. Page 55 - Add a discussion of the National Objectives (NED & EQ) as established by Principles and Standards.

5. Page 56 - The objectives are basically good but awkwardly written. Rewrite such as below.

Enhance the recreational opportunities in the Park River Subbasin for the benefit of the local people. In addition, if further studies are warranted then specific planning objectives should be identified to address the woodland and bushy areas, wetlands, and cultural and grassland resources.

6. Pages 57 and 62 - There are problems with the formulation of the levees and bypass system of protection for Grafton. The study is continuing, but in a reformulation category. Include in the assessment section a discussion of this issue.

7. Page 57 - Number 3 is not an alternative but a study to help develop alternatives.

8. Pages 57-61 - The assessment and evaluation sections need to emphasize how each alternative meets or does not meet both study objectives and National Objectives.

9. The design criteria, typical sections, cost curves, etc. used in developing the levee costs should be submitted for review to St. Paul District and referenced in the document.

10. Additional design analysis, i.e., geotechnical investigations, design and cost estimates, interior drainage analysis, etc., should be identified in Section XI, Additional Studies Needed.

11. The report should state why other alternatives (e.g., reservoirs, channelization) are not acceptable or feasible.

General Comments
Park River Subbasin Draft Report
(April 1980)

(These comments apply to the entire report and all subsequent subbasin documents)

1. Comments from Federal, State, and local agencies and a letter from the St. Paul District will be included in an appendix in each final subbasin and in the overall report. The format for the appendix will be:

a. Introduction - This section should stress:

(1) The importance of completing the study on time.

(2) That the purpose of the study is to advise other agencies and interests.

(3) The need for a selected review by various interests to provide complete and factual documentation.

(4) The use of the study as a building block for future water resource efforts.

(5) That cooperative efforts to evaluate results and develop solutions to remaining problems will be incorporated.

(6) A complete public involvement program when the study is finished.

b. The distribution list.

c. Copies of letters of comment.

Only comments that identify significant errors or need specific attention will be addressed in the final subbasin report. However, all comments incorporated should be identified with a marking system. The distribution list for the Park River Subbasin Report is given below:

Agencies receiving draft report	Date sent	Date comments received
Federal		
Soil Conservation Service	11 Jul 80	31 Jul 80
Fish and Wildlife Service	11 Jul 80	-
Corps of Engineers, North Central Div.	15 Jul 80	-
Corps of Engineers, St. Paul District	11 Jul 80	21 Jul 80

Incl 2

State

North Dakota Game and Fish	11 Jul 80	-
North Dakota State Planning	11 Jul 80	-

Local

Red River Regional Planning Council	16 Jul 80	-

3. The source for most information identified in the majority of the tables is Gulf South Research Institute. If other sources were used, an appropriate reference should be made.

4. When discussing the topography of the subbasin, care should be taken to maintain the same descriptions. For example, the locustrine plain should be identified as the locustrine lake or valley plain to distinguish this from the upland part of the basin.

Specific Comments
Draft Park River Subbasin Report
July 1980

* . Page 1, paragraph 3 - Change "southern Minnesota portion" to "northern North Dakota portion."

2. Page 2 - Other recent reports include a Flood Insurance Study at Grafton and a Watershed Study by the Soil Conservation Service for the North Branch Park River watershed. Evaluation did not produce an economically feasible plan and watershed planning assistance was terminated.

* 3. Page 3, paragraph 2, fourth sentence - "Forest" River should be "Park" River. Also, stream and topography slopes on pages 3 and 5 do not agree. Please correct.

4. Page 3, paragraph 2 - The town of Adams should be on the subbasin map so the Pembina Escarpment can be easily found.

5. Page 4, Figure I - There should be a legend to identify the two rows of short dashed lines found on the subbasin map. Also the escarpment should be located on the map.

6. Page 6, paragraph 2 - The town of Crystal is mentioned and should probably be shown on the map of the Park subbasin.

* 7. Page 8, paragraph 3 - "Prior" is misspelled.

8. Page 9, paragraph 2 - Again several locations (Cart Creek, Crystal, and Hoople) have been mentioned and probably should be identified on the floodplain map, Figure II, on page 7.

9. Page 9, paragraph 4 - Homme Reservoir is first mentioned here without an explanation of what this project is. It should be explained here or in an earlier appropriate section.

10. Page 12, Recreational Problems - Is the absence of water based recreation really a problem? A statement of the need or desire for additional water-related recreational facilities among the people should be included.

* 11. Page 13, top of page - Homme Lake and Homme Dam are one and the same. As written, they would seem not to be.

* 12. Page 15, Hydropower - At least five sites in the Park River subbasin were studied for possible hydropower use. All of them were screened out either because they were found to have minimum potential for hydropower development or were not economically feasible.

* 13. Page 15, Public Perception of Problems and Solutions - While the public's perception of problems and solutions may be adequately defined for a reconnaissance report for this subbasin (unlike many of the subbasins), the use of "well-defined" may be too strong a statement. Suggest replacing "well-defined" with "adequately defined for a reconnaissance report," in the first paragraph.

* 14. Page 17, paragraph 4 - "Attributed" is misspelled.

15. Page 18, last paragraph - Considering the insufficient stream flows as previously mentioned, would water supply also be considered a major problem in this subbasin, especially after this summer?

* 16. Page 18, last paragraph - Change sentence "...it is evident that residents of the Red River Basin consider flood control..." to read "...it is evident that most residents of the Red River Basin consider flood control...". The statement implies that this opinion is shared by all the residents of the basin. It is quite probable that some residents may think other water-related problems are more important, i.e., the farmer living in an upland area who has water supply problems.

* 17. Page 19, Social Characteristics - The first sentence states that population in the subbasin has steadily decreased. It is immediately followed by a contradictory statement which shows an increase in population from 1970 to 1977.

* 18. Page 20, Social Characteristics - What is meant by "close knit"? The implication is that this term is the same as that for social integration. While it is possible the communities in the subbasin have a high level of social integration, it is doubtful that the temporal measures alluded to would allow one to make such an assumption.

19. Page 20, Income - The distribution of income (such as percentage of population below the poverty level, etc.) should be included.

* 20. Page 21, Income - This paragraph should include a statement that says while state per capita income has risen 21.9% from 1969 to 1979, the subbasin income has risen only 14.8%.

21. Page 21, Agriculture - In addition to the factors noted on yield per acre, harvested acres, and total production for particular crops, it would be helpful if gross income per acre for particular crops were included. This information would give a better understanding of the relative importance of each crop. One other factor that would aid understanding of flooding problems is the differences in susceptibilities of crops to flood damages. Some crops are not as seriously affected by a flood event as others. In addition, the differences in costs per acre to plant particular crops would aid understanding.

* 22. Page 24, paragraph 2 - "Located" is misspelled.

* 23. Page 28, paragraph 1 - This should specify that white-tailed deer populations of > 1.5 deer per square mile are considered high only for North Dakota.

* 24. Page 30, paragraph 3 - Cite a reference for stream classification information.

25. Page 31, paragraph 3 - There should be more discussion on the inadequacy of Homme Lake to meet the water supply needs of Grafton. Also they have constructed a pipeline from the Red River to Grafton to supplement water supply needs. This should be discussed.

26. Page 32, Table 7 - The two examples given in this table don't appear to have excessive TDS and chloride problems since they are well within the standard limits. Perhaps a better example of the problem stated in the accompanying paragraph can be found.

27. Page 33, Table 8 - Are the concentrations given for each well significantly high? Standard values should accompany this table or the figures given are meaningless.

* 28. Page 36, paragraph 2 - Omit "and" in the third sentence.

29. Page 36, Social - In addition to the information presented, a discussion of the social consequences or implications of flood events should be presented, particularly those concerning behavioral damages that may occur.

30. Page 38, top of page - It should be stressed that a "systematic search" to identify additional potentially eligible National Register sites includes archeological, prehistoric and historic sites as well as architectural sites.

31. Page 38, Soils - The alluvial sandy soils are mentioned in this and the Pembina reports, but not in the Forest River subbasin report. Are they special to this region? If so, this should be mentioned.

* 32. Page 38, Water - The figure 0.2 percent stated here conflicts with the 2 percent figure mentioned on page 23 under Land Use.

33. Page 44, paragraph 1 - This should specify which species are listed as threatened or endangered only by North Dakota and which species are listed as threatened or endangered by the U.S. Fish and Wildlife Service.

* 34. Page 44, paragraph 3 - Specify that wireleaf cerquefoil is considered "rare and unique" in North Dakota.

35. Page 45, Most Probable Conditions and page 49, Without Project Conditions - These sections are confusing in that a prediction is being made that no action will be undertaken in the future to solve flooding problems that exist in the subbasin. This clearly is not the case, and as a project study is presently underway by the Corps of Engineers at Grafton, it would appear that "...a plan to alter resource management programs" is already being considered. Some clarification is needed.

36. Pages 53 and 59, Nonstructural Measures, paragraph 3 - By floodplain regulations do you mean floodplain zoning, flood insurance, flood proofing and flood evaluation? If not, the status of each of these measures should be presented.

* 37. Page 54, last paragraph - It states that Grafton accounts for "82 percent of total flood damages in this subbasin" whereas on page 47, in the first paragraph it says Grafton accounts for 65 percent of the average annual damages. This should be corrected.

38. Page 55, paragraph 3 - The second sentence should read, "Tangible economic benefits or appropriate gains in environmental quality must exceed overall costs."

* 39. Page 55, Planning Objectives - The second paragraph seems to be too strongly stated. The following rewrite is suggested:

> The development of planning objectives involved a broad-range analysis of the needs, opportunities, concerns, and constraints of the subbasin from the information that was available. On the basis of this analysis of the problems, needs, and desires that could be identified, the following planning objectives were established.

* 40. Page 57 - Although a levee and flood bypass channel at Grafton was authorized for construction, there was opposition at the local level. Citizens felt that the cost to them would be excessive and that the cost of operation and maintenance would create a perpetual burden on the city taxpayers. In response, the Corps is in Phase I of a study which will be a reformulation of alternative plans to determine if the authorized plan or an alternate plan better reflects public desires and meets NED and NEQ standards.

41. Page 57 - In formulating alternative measures, no mention was made of possible reservoirs for flood protection. According to an interim survey report for flood control and related purposes done in the Park River subbasin in 1973, there is at least one reservoir site that was economically feasible. This should be discussed in the final report.

* 42. Page 58, paragraph 2, third sentence - "Capital" is misspelled. "The" is misspelled in the fourth sentence.

43. Page 68, Additional Study Needs - It should be noted in each subbasin report that the probability of institutional and social boundaries being the same as subbasin boundaries is remote, at best. Since this boundary overlap exists, integrated basin-wide social and institutional analyses are desirable.